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"Scientific and Legal Objectivity in Legal and Regulatory Contexts: A Critical Approach to the Work of Sheila Jasanoff"

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Unlike other prolific writers, for me, even the few things I write are a product of labor.—Lafcadio Hearn, *Japanese Tales of Lafcadio Hearn*

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1. Introduction

1.1. Aim-Scope

Sheila Jasanoff's research focuses on the intersections of the sociology of knowledge, science, and institutions. Her interdisciplinary academic background, comprising linguistic studies and law, has definitely enriched her work; she combines the formalist style of law with a critical social-studies approach and the insightfulness of policymaking.

The present study aims to critically analyze her writings, focusing on scientific and legal objectivity in regulatory and legislative settings in the light of the co-production idiom. The current thesis consists of three main chapters.

In Chapter 1, namely "Co-Production of Law and Science", the reader may explore the relationship between science and law. In the first part of this chapter, some traditional narratives on the relationship between science and law are presented. This overview does not constitute a historiographic analysis. Instead, it aims to aid the reader in comprehending the co-production idiom, as a product of an STS analysis, through the evaluation of each commentary.

In Chapter 2, namely "Scientific Expertise and Objectivity in Legal and Regulatory Contexts", Jasanoff's views on expertise and knowledge-making in the courts and regulatory institutions are presented.

Finally, in Chapter 3, namely "Comparison with Competing STS Approaches", Jasanoff's approach will be critically analyzed in comparison to the competing STS approach of Bruno Latour.

One should not form the impression that the three chapters are independent of each other. The initial presentation of the co-production idiom is the foundation for understanding objectivity in regulatory and legislative context. Similarly, by comparing Latour's approach, readers can grasp all those subtle nuances and the descriptive richness of the views presented.

1.2. Methodology

It is essential to highlight that this is a literature review, meaning it is based on secondary sources and does not involve empirical data collection.

The theme of the study is highly person-focused; the name *Jasanoff* is repeated 194 times throughout the text. However, presenting Jasanoff's views in a manifesto-like manner was something to be avoided. The present thesis does not intend to summarize Jasanoff's literature but to critically analyze her writings, focusing on scientific and legal objectivity in regulatory and legislative settings in the light of the co-production idiom.

I started by scanning through all the writings of Sheila Jasanoff. The research process was initiated with the *Science at the Bar: Law, Science, and Technology in America* handbook to achieve a broader understanding of Jasanoff's work and, especially, of the co-production idiom.

Next, I studied selected chapters of the other books and the articles dealing with expertise, objectivity and knowledge-making. In order to find relevant sources for the current thesis, the snowball referencing technique was applied. Then I evaluated the works listed in the reference list based on essential books and articles. The advantages of this method include a quick examination of the relevant publications.

Jasanoff's references concerning legal provisions and court decisions are mainly derived from common-law legal tradition. I am fully aware that the present thesis is not a thesis on comparative law. As Jasanoff (2007) states, "STS analysis of law-science interactions has tended to focus on in-depth studies of individual cases or institutions rather than on varying practices across cultures or political systems" (p. 779). Therefore, this analysis does not have the form of an omnibus on US law. The names and unique numbers of court decisions are therefore mentioned as reference points.

Regarding the third chapter, I studied the book "The Making of Law: An Ethnography of the Conseil D'Etat" by Bruno Latour (2010), which Jasanoff often refers to. Next, I studied selected articles and chapters of his books, dealing with expertise, objectivity, knowledge-making, identities and institutions. Without a doubt, the study of a scholar cannot be performed based on how another one presents it. However, the purpose of this paper is not to show the different perceptions of Jasanoff and Latour coldly but to make the reader comprehend Jasanoff's ideas to the fullest through comparison. Therefore, in the third chapter, different STS approaches are being compared, not within the field of social studies, as in Chapter 1 but between different STS approaches.

The use of this multi-dimensional method has helped me gain a broad perspective on the literature review.

1.3. Prologue: The relationship between science and law

Jasanoff (1995) refers to science and law as "institutions of power." One can easily justify why. Many of the distinguishing aspects of contemporary societies can be attributed to science and technology (Williamson, 2019). On the other hand, social order itself is increasingly defined by law.

These institutions have several features in common. Since the commencement of the scientific revolution, the term "law" has been used to refer to both natural regularities and norms imposed by religious or secular authorities that regulate human conduct (Jasanoff, 2007). Both traditions hold an authoritative capacity to sift evidence and draw reasonable conclusions from it, both observe the reliability of observers/witnesses, both are concerned with rules and order, and any doctrinal authority does not bind both.

Their methods and "tools" are substantially different. Legal systems use human language, which is usually the language of the state that lends them legitimacy. Historically, the language

barrier has significantly reduced interaction among legal systems (Leclerc, 2005; Latour, 2002; Hermitte, 1996). On the other hand, as the presumed language of nature, science's language promises to be universal in a way that transcends culture, time, and location.

However, Jasanoff (2007) claims that even their historical evolution has not been distant. They have unavoidably influenced each other's discourses and prerogatives. Natural law continues to drive judicial decision-making, particularly in disputes involving the life sciences. Legal thinkers turn to nature searching for solid moral grounds, e.g., decisions on reproductive technologies reflect fundamental assumptions of what constitutes natural models of kinship or naturally gendered behavior (Hartouni, 1997). Notwithstanding, according to early modern scientists, nature was governed by law.

Until today, scientific and legal progress has been envisaged mainly in isolation from each other. However, vital aspects of modernity necessitate collaborative efforts between these two domains and their respective professionals (Jasanoff, 1995).

2. Chapter 1: Co-Production of Law and Science

2.1. Narratives on the relationship between science and law

Over time, several narratives have attempted to decipher the relationship between science and law. Jasanoff's attention has been drawn to four of them, which she refers to as "law lag," "culture clash," "crisis," and "deference."

2.1.1. Law Lag

Interestingly, the perception that law *lags (behind)* science and technology is prevalent in academic and popular discourse and has even gained support among members of the legal world. This narrative can be attributed to the American sociologist William Ogburn (1957), who argued that interconnected cultural institutions, such as science and law, develop unevenly. As a result, there is a constant need for adjustment between "leading" and "lagging" institutions due to the differential rates of innovation, accumulation, and diffusion. He argued that this irregular change between institutions is the primary source of social problems. In addition, as he believed science and technology were the primary movers of social change, he advocated for better statistical data to be the basis for establishing social harmony.

Law is portrayed as backward-looking, being dependent on judicial precedents and previously enacted rules. As Goldberg (1994, p. 19) states, "a judge disguises new ideas as old in order to enhance their social acceptability." However, these retrospective adjudication procedures seem incompatible with the demand for forward-thinking solutions to science and technology (Lieberman, 1981).

On the contrary, science is deeply linked to the future. The narrative of progress entails a discourse of empowerment and greater control through technology (Hoyer, 2004). In particular, the pursuit of innovation is so vigorous that it often sets aside science's history itself. Jasanoff (2007) notices that science is imagined as constantly evolving: "Continually erasing its own history as it moves forward, today's scientific knowledge ruthlessly casting aside yesterday's rejected theories and discarded truths" (p. 768). As a result, the law cannot help but act by the reaction.

Jasanoff does not contest this narrative as if courts cannot initiate their own action but should await complaints from aggrieved parties. Nonetheless, to her, courts are often the first institutions to host (formerly inaudible) debates (Jasanoff, 1995). Even concerning breakthrough advancements in biology, entrenched legal norms linger beneath the surface, constraining the language in which such discussions are framed (Jasanoff, 2001). Additionally, she comments on the artful absence of legal inventiveness in this narrative: She maintains the significant consequences a legal decision can have, especially in a highly entrepreneurial legal culture, as well as the courts' role in constructing new social and political orderings around science and technology (Jasanoff, 2007).

2.1.2. Culture Clash

The "culture clash" narrative supports that the conflict between science and law is attributed to their non-consistent aims. The gap between them seems unbridgeable, and their contrasts are often described in binary terms (Jasanoff, 1995). For example, science emphasizes progress, while the law emphasizes process; science seeks the truth, while the law does justice; science pursues the nature of reality as it is, while the law's primary concern is achieving consensus (Goldberg, 1994).

Peter Schuck (1993) triangulates the "culture clash" narrative by presenting politics as a third culture. He recognizes that each institution is characterized by its distinctive values, incentives, techniques, biases, and orientations. However, he profoundly associates science with a core commitment to truth and falsifiability, law with justice, and politics with a process (Schuck, 1986).

Therefore, according to the "culture clash" narrative, the demarcation of institutions entails solid boundaries. However, this notion is challenged by STS scholars who support that these boundaries can be erected and are artificially maintained (Hilgartner, 2000; Gieryn. 1999, Jasanoff, 1990). Concerning demarcation in legal settings, Caudil and Redding (2000) specify that the STS mission is to persuade judges that simple, rigorously enforced demarcation criteria are of doubtful use in determining the local relevance and value of expert testimony.

2.1.3. Crisis

The American-themed narrative of "crisis" obviously portrays the science–law relationship as being in crisis: These institutions are so incompatible that any interaction between them is doomed to failure.

On a first level, this commentary is concerned with the economic problems supposedly caused by the synergy of these two institutions. For example, Lieberman (1981) claims that America's "litigious society" is to blame for the ever-increasing insurance costs. "Irresponsible lawsuits have resulted in high awards against physicians, who seem undefended in this "malpractice crisis." Furthermore, case-by-case adjudication produces inconsistent outcomes in examining technical evidence, causing uncertainty among companies and professional groups (Jasanoff, 1995, p. 6).

However, this reading is not supported by statistical analysis. Counternarrative surveys report that only a small fraction of those who have been injured ever file claims (Sage and Kersh, 2006). Furthermore, the growth and decrease of insurance rates may have more to do with insurance company investment cycles than with malpractice claims (Sage and Kersh, 2006).

Figures aside, Jasanoff (1995) believes that lawsuits are vital in how society grapples with technological development's moral and institutional dimensions. The "crisis" framework seems to attack the litigation system as a whole blindly. It fails to explain why courts remain an

indispensable (and often appealing) forum for resolving controversies (Vidmar, 1995). It further fails to explain why, when the public is concerned about the results of science and technology, it turns to the law to regain control over the processes of scientific and technological development (Jasanoff, 1995).

On a second level, the "crisis" commentary focuses on how law abets the production of "junk science," namely science that does not meet the scientific community's minimum standards of validity (Huber, 1991). Jury ignorance and confusion, lack of sophistication, mercenary and unprofessional expert witnessing, careless admissibility of standards, and the lawyers' ethos of privileging victory over the truth are some reasons why courts are accused of deficiently perceiving ("proper") scientific knowledge.

Jasanoff highlights that the law has its own rules and practices for choosing admissible evidence, which are different from those of science. For example, courts may be at first assured that evidence is relevant to the dispute at hand. Legal admissibility standards differing from scientific ones do not make the former unscientific by definition (Jasanoff, 1995).

Finally, the "crisis" narrative is regularly paired with the "culture clash" narrative; law professionals, being "technically illiterate," misuse scientific evidence. Similarly, they, being swayed by external influences and pecuniary interest, as well as occupied by adversarial zeal, often manipulate truth and rationality (Angell, 1996). Besides, according to Angel, since litigation is centered around adversarial disputes of competitive parties, it is opposed to science, as it undermines the cooperation and "slow accumulation of evidence from many sources" (Angell, 1996). These circumstances produce a settlement for scientifically untenable public policies.

Jasanoff (1998) comments that, in Angell’s terminology, the word “scientific” is virtually synonymous with 'epidemiological'. Angell's brief (US Supreme Court, 1996), according to which general causation in toxic tort cases can only be established through observational epidemiological research, aims mainly to elevate epidemiology's scientific and professional standing.

Disproving every deterministic aspect of the "crisis" narrative is not the aim of the present analysis. However, concerning how external (political) influences affect courts, it is worth noting that Jasanoff does not consider litigation to be an ivory-tower-like institution, separate from the outside world. Instead, she believes that "litigation is too pervasive a feature of a political culture" (Jasanoff, 1995, p. 206). The way courts respond to individual complaints is not subject to politics influencing adjudication but is related to how political culture is constituted.

One can easily acknowledge that both aspects of the "crisis" narrative are centered on litigation, and conveniently dismiss to mention legal contexts out of the courtroom.

2.1.4. Deference

The "junk science" narrative laid the conceptual ground for the fourth narrative concerning the relationship between science and law. Its name, "deference," signifies the complaisance by courts toward science and scientists.

In the 1993 decision *Daubert v. Merrell Dow Pharmaceuticals*, it was ruled that judges should act as gatekeepers in contests over the admissibility of scientific evidence. In other words, they should ensure that only scientifically valid and reliable evidence is admitted to court. As analyzed in the next chapter, *Daubert* offered four nonexclusive criteria for separating valid and invalid science: testability, peer review, error rate, and general acceptance.

Judges have already had the power to reject expert testimony under the Federal Rules of Evidence, which provided that expert testimony is admissible only if it "is the product of reliable principles and methods" (Rule 702 of Federal Rules on Evidence), but they rarely exercised that discretion. *Daubert* took that prerogative and turned it into an affirmative obligation (Jasanoff, 2007). Thus, post-*Daubert* judges should defer to the science, as shaped by their culturally conditioned knowledge of the scientific process and mediated through the needs of judicial practice.

Daubert laid the foundations of a growing industry in scientific training for judges who should show deference to the scientific community. The American Association for the Advancement of Science compiled a list of *trustworthy scientists* for use at court, namely the Court Appointed Scientific Experts (CASE). The Federal Judicial Center published in 1994 the *Reference Manual on Scientific Evidence*, a desktop guide for federal judges including articles on technical and scientific evidence. In keeping with the theme of deference, Jasanoff (2007, p. 771) highlights the chapter entitled "How Science Works" by David Goodstein, which is contained in the manual (Federal Judicial Center, 1994, p. 67-82).

As further elaborated in Chapter B, Jasanoff offers a more sophisticated reading on *Daubert*, as she recognized that expert knowledge is not entirely compatible with scientific knowledge within a legal context, outlining the different forms of knowledge certification. *Daubert* criteria should not be interpreted as a fixed set of rules for establishing expertise when circumstances are falling under none of the criteria. Moreover, the criteria presuppose a level of autonomy on the part of the judge, which is inconsistent with the expertise game's "interactive" and "locationally distributed" nature (Jasanoff, 1998; 1995).

Subsequently, Jasanoff suggests another spectrum of describing the relation between law and science, not in terms of deference but of co-production.

2.2. The co-production idiom analyzed

The narratives discussed above (namely *law lag*, *culture clash*, *crisis*, and *deference*) emanate primarily from professionals is the scientific or legal fields. The co-production idiom is the only STS approach concerning the relationship between the institutions of law and science.

It is worth mentioning that STS research was developed to include various studies of the cultural assumptions and meanings of science and technology. One longstanding idea in anthropology is that symbolic and material orders were co-constituted or co-constructed (Hess and Sovacool, 1995). This notion suggests that different fields of study cannot be seen as separate realms but need to be studied together. As a critique to determinism, co-constitution and co-construction encourage the fruitful combination of theories, avoid constructed boundaries set by realism and replace simplistic notions such as "intervention," "impact," "acceptance," or "solution" with a richer vocabulary that theorizes on the co-constitution between symbolic and material orders (Paine and Neven, 2018). In that spectrum, Jasanoff suggests (1995) a different form of knowledge production where natural and social orders are produced together: that is, they are co-producing each other. However, she does not advocate for just constructing a representation of the world as it is, but also a representation of the world as social orders want it to be. As it is not restricted to material objects but, also, deals with ideas and institutions, Jasanoff's co-production aims to provide inside both on the ontology and epistemology of STS topics.

Jasanoff (2004) suggests that the traditional disciplinary languages (economics, sociology, and political science) lack vocabularies that make sense of the untidy, uneven processes through which science and technology production becomes intertwined with societal norms and hierarchies. Society cannot be thought of as the formation of interest groups with clearly articulated positions and preferences. Even anthropology studies often overemphasize locality and sacrifice some other social sciences' abstraction and generalization capacities.

On the other hand, sociology and political theory often ignore science from their analytical agendas (technology slightly less so), of course, with noteworthy exceptions (Bourdieu, 1980; Habermas, 1975). Especially in science, there have been no attempts to establish systematic links between the micro-worlds of scientific activity and the macro-categories of social thought (Jasanoff, 2004). Therefore, the engagements between the agencies of science and law remain a largely unexamined issue for traditional frameworks.

Co-productionist accounts do not seek to create a strict methodological framework with lawlike-consistency and lawfully predictive power. Unlike the "law of nature", co-production does not entail a claim to an all-powerful truth. For this reason, the term "idiom" is chosen. Actually, it is a means for modern societies to form their epistemic and normative understandings without being deprived of depth or sophistication. Its goal is neither to give deterministic causal explanations for how science and technology impact society nor vice versa. Therefore, it is associated with the interpretative and post-structuralist turn in the social sciences (Jasanoff & Wynne 1998; Latour 1988b).

Its main contribution is interpreting complex phenomena and avoiding strategic deletions and omissions of most other approaches in social studies. It presents new perspectives on power, highlighting the often invisible role of pieces of knowledge, expertise, technical practices, and

material objects in shaping, sustaining, subverting, or transforming authority relations. Furthermore, it makes resources available for systematic thinking on the sense-making processes by which humans come to terms with realities in which science and technology have become permanent fixtures. These features define the idiom's descriptive richness, which is derived from providing fuller, more profound accounts of how patrons of science and social configurations are interconnected (Jasanoff, 2004).

As already mentioned, the idiom reflects the desire to avoid both technoscientific and social determinism in STS accounts of the world:

On a first level, scientific and technological changes do not emerge fully formed in response to innovation and discovery. Similarly, science and technology's workings no longer exist in isolation from other kinds of social activity but are instead interwoven as necessary components in society's progress. As Jasanoff (2004) states, "we are not mere spectators whose responses and destinies are ineluctably transformed by the growth of knowledge and the acquisition of novel technological capability" (p. 16). Alternatively, as Smith and Marx (1994) put it, technology does not drive history. Societal investments in science and technology both lead and are led by institutions.

In reverse, it should not be assumed that co-production portrays science as any different from any other social practice. If we consider social practices, identities, norms, conventions, discourses, instruments, and institutions as the elementary units of what we call social, science embeds and is embedded in all of them. Technology may be asserted much more firmly in this regard. However, science and technology are not just socially constructed (Hacking, 1999). In Jasanoff's words (2004), "what counts as ‘social’ about science itself is a subject of unsuspected depth and complexity" (p. 20). The opposite presumption would cause the following issues to arise:

- On a theoretical level, social reality does not ontologically lie before natural reality, nor do social factors alone determine nature's workings. In other words, there is no causal primacy of the "social" over the "natural," something which has persistently been accepted (Collins, 1998; Pickering, 1995; Woolgar, 1988). To demonstrate this notion, Jasanoff (2004) uses the vivid example of the title change of Bruno Latour's and Steve Woolgar's 1979 seminal study. In fact, the "The Social Construction of Scientific Facts" original subtitle of the 1979 edition was changed to "The construction of scientific facts" in the 1986 edition (Latour and Woolgar, 1979; see also 1986 edition).
- On a practical level, considering one aspect of social reality (be it interests, capital, gender, state, or the market) as granted practically excludes further analysis on it. This fundamental-like treatment creates a "black box," which prevents the symmetrical probing of science and society (Scott et al., 1990). As a result, social constructivists

have been accused of reflexively deconstructing science, as they lack a neutral research starting point (Woolgar, 1988). The reduction of science to a consignee of social determinism is not an aim of co-production, either.

Co-production expresses how scientific ideas and beliefs evolve with the representations, identities, discourses, and institutions that give practical effect and meaning to these very ideas and objects. Traditional frameworks cannot sufficiently describe the terms in which we think about ourselves and conceptualize how we perceive our positions in the world (Hacking 1999; 1992; Foucalt 1972). According to Jasanoff (1995), one can only acknowledge modern cultural and political formations via the prism of co-production.

The institutions of science and law are so profoundly intertwined that a close examination of legal practice is likely to shed light on the generation of scientific knowledge (Jasanoff, 1995). In that spectrum, the boundaries between the legal and scientific spheres of influence are themselves at stake. Concerning expertise, for example, Jasanoff claims (2007) that legal spaces operate simultaneously as epistemic evidence.

Accounts of the evolution of science are incomplete unless the shaping influences of legal imperatives, legal practitioners, and justice institutions are considered (Jasanoff, 2007). In other words, the law does not restrict itself to the interpretation of science and technology, but it also constructs the environment in which science and technology come to have meaning, utility, and force (Jasanoff, 1995). Moreover, many critical issues of modernity necessitate collaborative efforts between law and science. These two institutions both offer a broader understanding of how aspects of social order function. Co-production calls for symmetrical attention to the constant intertwining of the cognitive commitments and understandings to structures of reality.

As a result, there is a need for balanced research on their practices, as each underwrites the other's existence in ways that have previously escaped systematic analysis (Jasanoff, 1995; 2004). Besides, our understanding of their relation heavily depends on how we approach the research on each institution's fields. As Latour suggests (1993), what one understands in science is heavily influenced by past or concurrent decisions about learning it.

The ways we represent nature and society are inseparable from how we choose to live in it. Knowledge and its embodiments are social products and constitutive forms of social life: "co-production is not about ideas alone; it is equally about concrete physical things" (Jasanoff, 2004, p. 6).

Co-production is the framework where natural and social orders are produced together. Therefore, it criticizes the realist ideology that constructs and maintains barriers between nature and culture, facts and values, objectivity and subjectivity, reason and emotions, policy and politics (Jasanoff, 1995; 2004). Science is not a transcendent mirror of reality, as well as scientific knowledge is not a byproduct of political agendas. In Latour's (1993, p. 94) terms, "Society, as we

know, is no less constructed than Nature, since it is the dual result of one single stabilization process." The interconnectivity of nature and society concerns the entirety of social studies.

Bibliographically, the co-production idiom has tended to cluster around four recurrent themes. These are a) the *emergence and stabilization* of new technoscientific objects and framings (how people recognize and assign meaning to them), b) the resolution of scientific and technical *controversies* (the process by which ideas gain supremacy over competing ones), c) the processes by which the products of technoscience are made intelligible and portable across *boundaries*, and d) the adjustment of science's *cultural practices* in response to the contexts in which science is performed (Jasanoff, 2004).

Finally, Jasanoff expresses that co-production's wish to provide a comprehensive model of understanding scientific changes and institutional knowledge-making, encouraging a more productive dialogue between traditional and contemporary STS approaches.

3. Chapter 2: Scientific Expertise and Objectivity in Legal and Regulatory Contexts

3.1. Truth and Objectivity

Should one perseveringly keep reviewing the law–science relation, they will apparently survey each tradition's approach to facts. Both institutions share common aims in fact-finding since science is concerned with obtaining the "right" facts or in other words "at least to the extent permitted by the existing research paradigm or tradition" (Jasanoff, 1995, p. 9); the law also aims to establish facts "correctly" in order to handle conflicts with fairness (Jasanoff, 1995, p. 9). As Lazer (2004) suggests, rendering justice depends on finding the correct facts and finding them right. Moreover, no matter how facts are differently contested in legal contexts, both institutions claim an authoritative capacity to evaluate evidence and draw reasonable conclusions from it (Fuller, 1969).

Finding the "right" namely, truth itself (Shapin, 1994)—has long been a central issue in the philosophy of knowledge (Rorty, 1991). Psillos (2007) suggests that when specifically applied, truth and rationality are intimately connected with objectivity. Indeed, since the first stages of its emergence, modern science has been conceived as delivering facts objectively (Daston & Galison, 2007). By claiming objectivity, one claims to be able reason, even avoiding political judgment (Jasanoff, 2011b).

As in the dictionary definition (see definition 5 of "objective" online at http:// dictionary.reference.com/browse/objective), something is objective when it is not influenced by personal feelings, interpretation, or prejudice; it is based on facts; it is unbiased. The objectivity of science has been associated with truth, rationality, and value freedom. This latter feature is considered fundamental for assuring science's objectivity. Merton (1942) describes scientific claims as being "universal," thus evaluated in terms of universal or impersonal criteria and not based on race, class, gender, religion, or nationality. Jasanoff (2011b) suggests that objectivity partakes of the neutrality and impartiality of science itself. As a historically bound feature of science, objectivity refers to anything independent of particular points of view, perspectives, subjective states, and preferences and is opposed to subjectivity (Psillos, 2007, p. 168). Based on how that demand for independence is interpreted, Psillos further distinguishes two different senses of objectivity.

The first is *inter-subjectivity*, assessed as the point of view common to all subjects. This view on objectivity has been mainly linked to the scientific method, which has been portrayed as capable about creating "rationally justified knowledge" of the universe.

The second sense is *radical objectivity*, which is assessed as a form of total subject separation, understood as "mind independence" or "knowledge independence." Radically objective entities can exist independently of being perceived (Psillos, 1999). In that sense, science is objective because it reveals how the world truly is, regardless of viewpoints. This notion has been fundamental in the battle against Aristotelianism (Williams, 1985).

The concept of objectivity acquires more concrete content when it is applied to particular instances, as, for example, the objectivity of belief or the objectivity of scientific method. In such cases, the notion is inextricably linked with truth and rationality (Psillos, 2007). Therefore, the objectivity of the scientific method has been assumed to be the result of this technique's intellectual justification. Since many critical issues of modernity necessitate collaborative efforts between law and science, increasingly more commitments have been made to justice institutions to cloak their judgments with the "objective" authority of scientists, technology experts, and their respective instruments (Jasanoff, 1995). However, is relying on "neutral" (or "value-neutral") science a courts' best way to find facts and thus to ensure justice?

3.2. Moving Science's Neutrality in a Legal Setting

In the context of legal proceedings, ideas of truth and ideas of justice are co-constructed: "The legal system has long looked to science as an indispensable ally in a shared project of truth-finding" (Jasanoff, 1995). Historically, every legal system has sought to acquire scientifically valid facts which are unaffected by values or social interests. The latter aimed to provide the foundation for exercising their normative power (Jasanoff, 2007). However, as Jasanoff highlights (1995, p. 207), "good science is not a commodity that courts can conveniently shop for in some extrasocietal marketplace of pure knowledge."

Contrary to the deterministic risk paradigm, there is no linear, chronological link between scientific closure and legal controversy; science and technology are not proactive, while the law is reactive (Jasanoff, 1995). It has already been mentioned that courts do not await scientific disputes to arise but often are the first forums to host formerly inaudible debates, providing an "envelope of social order," where new epistemic constructs and technological objects are continuously outfitted (Jasanoff, 2007). Similarly, no judicial inquirer can postpone a decision opting to wait for further scientific research to be conducted. In disproving this chronological relation, Jasanoff (1995) maintains that scientific research is often conducted after litigation has produced a decision and identified a possible causal link. As a result, justice institutions cannot rely on a value-neutral, objective science simply because the latter often does not exist when a dispute is brought before a court.

However, even if context-specific, deterministically value-neutral, objective, and not socially constructed scientific claims (pre)existed, the courts' reliance on them remains problematic. Scientific data must nevertheless be aggregated and reanalyzed to solve the litigation-related concerns, often using contentious scientific methodologies, such as meta-analyses. As evidential gaps are quite common, context-specific material must be collected. This material, which is generally of low importance to scientific study itself, usually predates the legal battle, and even if it is eventually published, it may never be independently evaluated (Jasanoff, 1995). As this information is rarely independently evaluated, it is respecified to elaborately

support or refute a litigant's narrative (Jasanoff, 2002). Moreover, litigant narratives influence the selection and reexamination of that data.

The overhead view of objectivity adheres to a notion of it being a representation of nature (Daston & Galison, 2007). Likewise, the production of scientific testimony for the courtroom is bound up with cross-cutting institutional and political imperatives that complicate the notion of science as free-standing and independent of the law (Jasanoff, 1995). Courts, however, have their own rules and practices for choosing admissible evidence. For example, courts may be at first assured that evidence is relevant to the dispute at hand or that one's testimony does not usurp the role of the judge. So, the question arising is none other than the following: if legal admissibility standards differ from scientific ones, how are objective claims secured in a legal setting?

3.3. Expert Claims and Admissibility

Not merely as adjuncts to legal fact-finding but as aiders in deciphering new forms of life, scientifically trained professionals have increasingly been making their appearance in justice institutions. Expertise is something that is not lacking in courts. This has reasonably raised the issue of distinguishing actual experts from frauds. Ultimately, whose claims are admissible?

Distinguishing admissible from inadmissible claims of expertise is no less critical to law than science itself. The status and credibility of courts are at stake: If a legal system could not impose these demarcations, it would have been indefensible. In testing the credibility of experts, the law reaffirms its credibility. In Jasanoff's words "Scientific validity [is] a precondition for rendering justice" (1995, p. xiv).

Huber (1991) claims that standard rules or criteria will assist judges in discerning between legitimate and "false" science. Others believe specially appointed experts or panels will provide the answer. However, such formulaic methods fail to account for the uncertainties that govern the production of scientific knowledge (Jasanoff, 1995). As expert evidence is derived from disparate and different (if not contradictory) sources, relevant expertise is not easy to trace (Harr, 1995). Disputed facts may even arise in inquisitorial legal systems, where the judges control the production of evidence as a right (van Kampen, 1998). Moreover, the purpose of expert testimony is to support or refute a litigant's narrative in an elaborate manner.

Jasanoff (1998) suggests that the demarcation between 'good' and 'bad' expert testimony cannot be set by external scientific authority. Any fixed and definitive criteria for evaluating scientific liability seem to cause more problems than they solve. Firstly, they would significantly reduce the number of cases reaching the court, as only specifically research-related claims could be filed (Jasanoff, 2002). Secondly, the court's decisions would be pre-certified under the standards set by science. Thirdly, courts would be transformed into dueling grounds for experts (Jasanoff, 1995). In her words, "No unambiguous rules applied impartially and without variance by Solomonic judges" (Jasanoff, 1998, p. 103).

Evidence (i.e., law's distinctive contribution to knowledge-making) is a hybrid product of legal and scientific reliability criteria. As a result, clarification must be sought within the contexts in which evidence is produced. A greater understanding of the mechanisms by which experts acquire or lose credibility in the eyes of the law will guide us to whose claims are admissible. Expertise may be viewed as the result of a complex contest, which involves its own "distinctive moves, countermoves, rhetoric and practices, which can be simultaneously played by multiple actors (such as judges, juries, lawyers, scientists, witnesses, and professional communities)," both inside and outside the courtroom (Jasanoff, 1998, p. 84). For this reason, the present thesis is not limited to legal research, but it also concerns regulatory contexts. Matters on expertise may arise in different legal settings.

3.4. Who are Those Experts?

As a litigant's narrative is intimately interconnected with expert evidence, it is essential to analyze *who those experts are*. Jasanoff (1998, p. 85) claims that in everyday speech, the expert quality is linked to performance: "a cook, a salesman or a piano tuner, for instance, can be designated 'expert' for simply measuring up to certain conventional performance standards." In contrast, if a professional's craft is exceeded by any predetermined repertoire of rules (like a violinist, mathematician, or theatre critic) the "expert" label seems reductionist. However, it is readily admitted that artists, inventors, and technicians all possess some level of expertise.

In a legal setting, expertise encompasses the special competence that we call 'science,' but it is a broader notion. Consequently, individuals of "special knowledge, skill, experience, training, or education" may be termed as "experts," as indicated by Rule 702 of the US Federal Rules of Evidence (Testimony of Experts). In other words, their level of learning or mastery should exceed the ordinary.

With that many cognitive and experiential pathways to expertise, the legal term of "expert" may be faced with skepticism (Gieryn, 1995), as any human activity appears to be capable of falling under the "expert" term, at least superficially. However, expertise is not subjected to complete relativity. The legal system has unique methods for assessing scientific evidence, shaped by its requirements, restrictions, and purposes. Contrary to the traditional narratives analyzed above, these discrepancies do not render the law anti- or unscientific, but they highlight the different nature between legal and scientific fact gathering (Jasanoff, 1995; 1998; 2004).

3.5. Focus Points

Jasanoff unravels the journey of expert witnessing by highlighting a handful of landmark court decisions regulating the admission of expert testimony in judicial processes:

The first professionals to become acceptable as expert witnesses in common law jurisdictions were medical witnesses (Milroy, 2017). As quoted in the *Buckley v. Rise* case from 1554, "If matters arise in our law which concern other sciences or faculties, we commonly apply for the aid of that science of faculty which it concerns, which is an honorable and commendable thing in our law, for thereby it appears that we do not despise all other sciences but our own, but we approve of them, and encourage them as things worthy of commendation […] In an appeal of mayhem the Judges of our law used to be informed by surgeons whether it be mayhem or not because their knowledge and skill can best discern it" (Saunders, J., in Buckley v. Rice, 1554, p. 124).

The experts' right to speak in general on matters within their particular competence is conventionally traced to the 1782 case of *Folkes v. Chadd*, which laid down the first rules on the admissibility of opinion evidence in the common law. This foundation was later put into the following words, "*'The opinion of scientific men upon proven facts may be given by men of science within their own science.' An expert opinion is admissible to provide the court with scientific information which is likely to be outside of the experience of a judge or jury"* (R. v. Turner, 1975, 1 All ER 70.). However, the ultimate power to decide who should testify undoubtedly belonged to the judges, just as the power to "find the facts" ultimately rested with the jury (Jasanoff, 2002).

The starting point concerning the admissibility of evidence can be traced back to the 1923 appellate court decision *Frye v. the United States*. It stated that evidence could not be admitted unless it was generally accepted, underlining that the thing from which the deduction is made must be "sufficiently established to have gained general acceptance in the particular field in which it belongs" (293 Fed. 1013, 1923). Only peer-reviewed studies and testimonies could be admissible. However, as diverse meanings of "general acceptance" gained traction, the Frye rules proved difficult to apply consistently. Despite this, *Frye* remained the leading test for admissibility for 70 years.

Finally, in 1993 a new decision, *Daubert v. Merrell Dow Pharmaceuticals, Inc.* (509 U.S. 579, 1993) came to offer four simple criteria for determining the admissibility of scientific evidence, vitiating the Frye Rule: a) whether the science in question was testable and had been tested; b) whether it was peer-reviewed; c) whether it had a known or a potential error rate; and recapitulating Frye as just one test among others, d) whether it was generally accepted within the relevant scientific community. These criteria were evaluated as an incident for judges "to think like scientists" in evaluating scientific evidence. In other words, they were required to act as gatekeepers concerning scientific evidence, keeping out any expert testimony that is not reliable or relevant (Jasanoff, 1995).

Since *Daubert*, skepticism about peer review looks to be gaining support as well. In that same year, *Valentine v. Pioneer Chlor Alkali* case dismissed an expert's testimony even though he

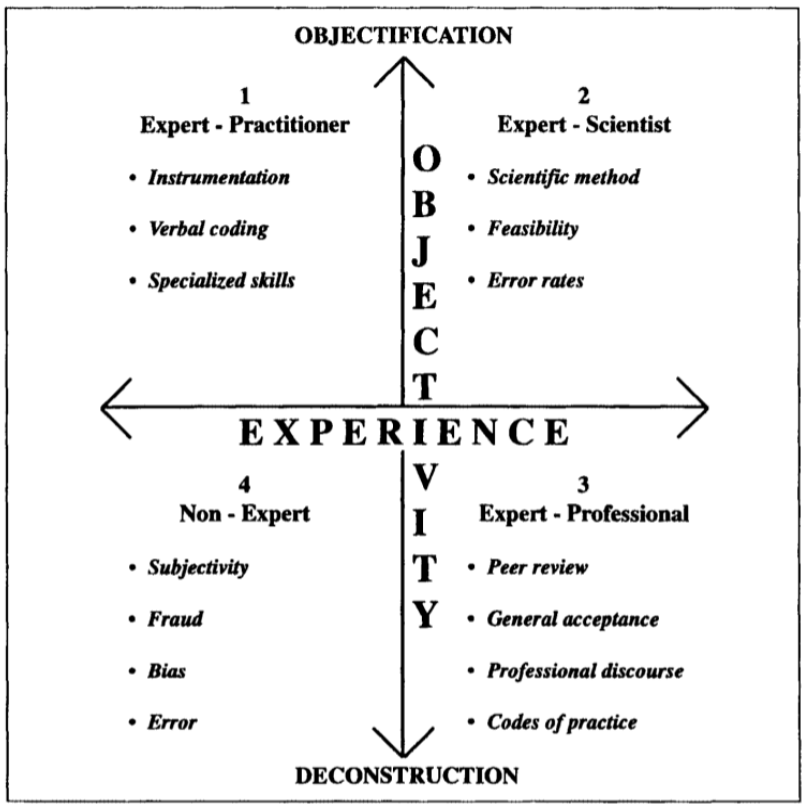
had published a paper in a peer-reviewed publication. It stated that this publication was not legally cognizable as 'real' peer review, asserting that "militating against forensic use of editorial peer review as a proxy for genuine critical examination of purportedly scientific evidence is the fact that the average referee spends less than two hours assessing an article submitted to a biomedical journal" (Supreme Court of Nevada, 1993).

Later, the *Kumho Tire Co. v. Carmichael* decision of 1999 came to extend the judiciary's gatekeeping role in technical evidence. It clarified that not just scientific evidence but all expert evidence is subject to the *Daubert* rules. Judges are the ones to determine what constitutes sufficient reasoning by expert witnesses in their courts, "above and beyond any tests […] from science's repertoires of legitimation" (Jasanoff, 2002, p. 51). These decisions have led legal actors to construct expertise more transparently than during the shadowy Frye regime (Jasanoff, 1998).

3.6. Jasanoff's Expertise Game

However, is expertise constructed? Individuals seeking recognition as experts compete for credibility in the eyes of the fact finder in a legal framework. This "expert making" process (with its written and unwritten rules) is graphically portrayed by Jasanoff (1998) as a "game," as both written and unwritten rules are used. Her dynamic model seeks to assist us in sorting out and comparing the different claims of competence that come before the courts in complex litigation. The "game of expertise" is described as follows:

Two imaginary axes divide the imaginary expertise board into four quadrants. Together, they define the spaces in which expertise can be asserted or challenged.



Picture 1: The *expertise game* as pictured by Jasanoff in *Expert Games in Silicone Gel Breast Implant Litigation (1998, p.88).*

3.6.1. Horizontal Axis: Experience

The horizontal axis—labeled "experience"—accommodates moves designed to professionalize the knowledge claims of expert witnesses. Experts must embody the collective judgments of a field, occupation, or profession to be recognized as such. Although a sine qua non of witnessing more generally, personal trustworthiness is not enough for them to merely embody credibility. Their success is dependent on developing a twofold claim on the fact finder's trust: as individuals and as representatives of a community of professionals. The latter instinctively arises since the evidence is not restricted to prove guilt and causation, but it creates acceptable behavior baselines in several fields of professional practice, such as medical malpractice, scientific misconduct, or child abuse.

Likewise, expert credibility can be undermined by attacking either their personal or their professional integrity. Thus, the claim's position on the horizontal axis is defined by whether the source of the relevant experiential authority is personal or professional.

3.6.2. Vertical Axis: Objectivity

The vertical axis—labeled "objectivity"—designates efforts to move expert evidence from the pole of untested or subjective observation (e.g., eyewitness testimony) towards that of a scientific fact. There, the expert claim is not unique to the expert himself. Hence, the claim's position on this axis is defined by facticity, namely objectification or deconstruction.

The closer an expert testimony adheres to scientific norms, the more the weight that it carries. It follows that science is traditionally regarded as distinct from all other social activities because of its institutionalized processes for overcoming particularity and context-dependency and its potential to make claims of universal validity (Jasanoff, 1995). As a result, admission judgments have tended to favor evidence bearing some commonly recognized hallmarks of impartiality, such as quantification, instrumental readings, x-rays, and photographic representations (Jasanoff, 2002). Even though its conclusions may be speculative, provisional, and liable to change, science is committed to systematically testing its observations and is willing to submit its conclusions to critical probing and falsification (Ayala and Black, 1993). Consequently, the labels 'scientist' and 'scientific' have proved to be a bone of contention.

According to the above, a claim is less likely to be the subject of ad-hominem attacks if it appears scientific. As Jasanoff (1998, p. 87) describes, "[a]n expert who represents science speaks for a reality presumed to be beyond mere individual experience. [...] Science's cultural authority underwrites its objectivity". Moreover, the personalities and viewpoints of experts become irrelevant as long as their claims depend on exogenous standards of validity. Even their personal

biases are obfuscated if their testimony appears to conform to objective standards (Jasanoff, 2011b).

3.7 - Sorting Out and Comparing Expertise

In order to gain expert recognition, individuals must push their assertions toward scientific objectivity and verified professional expertise. Given that the authority of both science and law depends on appeals to transcendental truths, no expert can allow themselves to be perceived as subjective, arbitrary, or entangled in the particularities of individualism (Jasanoff, 2007).

The first three quadrants, moving clockwise from the top left, reflect areas where competence can be claimed on different grounds. When disputing expert claims, the goal is the reverse. Only into this space can expert claims be considered to satisfy neither the relatively stringent tests of scientific reliability nor the broader standards of professional expertise.

Further, a more refined characterization may be provided in each quadrant by explaining the precise paths taken in building up or breaking down the claims of competence:

- In the first quadrant, the goal is to enhance the objectivity of lay experience by stressing its skilled, disciplined, or knowledgeable character. In this domain, the skillful deployment of instruments and professionally established techniques (like X-rays, models, microscopy, and photography) can help clothe individual observations in the guise of credible expertise (Jasanoff, 1998). This frequently results in evidence being considered variable by the court, with no question of admission raised.
- In the second quadrant, moves are designed to tie expertise explicitly to scientific methods and the objectivity of science.
- In the third quadrant, expert claims are linked to the judgment and experience of professional communities but not necessarily to science. Here discursive strategies aim to represent personal observations as professional experience.
- In the fourth quadrant, by contrast, the permitted moves are largely deconstructive; when moving down the objectivity axis, concerning the claim's scientific merit, and along the horizontal axis from professional to personal, expertise ceases to exist. The would-be-experts are deprived of the resources of specialized "knowledge, skill, experience, training or education" (Jasanoff, 1998, p. 88) being reduced to lay witnesses of no particular skill. Personal integrity is another possible target in quadrant 4. Cross-examination can be used effectively here to show personal prejudice, wrongdoing, financial interest, or contradiction on the side of particular experts. Interestingly enough, Jasanoff (1998) notices

that cognitive bias receives less attention from judges than possible pecuniary interests.

However, this classification does not credit the complicated dynamics of actual situations, with simultaneous, conflicting movements by multiple parties. The expert-making process seldom takes place following predetermined places. Winning methods frequently include purposeful linguistic repertoires, stage performances, and adaptation to choices made by other players claiming higher scientific or professional authority (Jasanoff, 2002). Along these lines, as courts aim to produce localized and context-specific solutions to disputes brought before them, expertise in legal settings is formed interactively and is locationally distributed, not being subordinated to inappropriately universal standards.

3.8. *Daubert* Reviewed

Understanding of Jasanoff's model provides a foundation for refining the decisions that should regulate the admission of expert testimony in judicial processes. For example, under this light, *Daubert* takes on a far more sophisticated context. First, it stops being a general injunction for judges to 'think like scientists.' Secondly, it recognizes that expert knowledge is not entirely compatible with scientific knowledge within a legal context, outlining the different forms of knowledge certification.

Out of the four *Daubert* criteria, two (testability and error rates) refer to moves along the objectivity axis, by which experts lay claim to scientific reliability; the other two criteria (peer review and general acceptance) refer to moves along the axis of experience, from personal to professional (but not necessarily scientific) knowledge (Jasanoff, 1998).

However, one can effortlessly think of circumstances falling under none of these criteria. Taking "falsifiability" as an example, Jasanoff highlights that this criterion is only related to Karl Popper's model of experimental science, and has little relevance to other forms of scientific activity. Additionally, it is unclear if the "peer review" criterion refers to the expert's conclusions or methodology. Moreover, none of the criteria expressly examine the role of material resources (namely, equipment, reagents, test animals, photos, software, or computerized databases) in creating 'objective' scientific knowledge, despite their widespread use in scientific practice (Latour & Woolgar, 1986).

Similarly, there is no mention of professional codes or protocols used to support claims on professional expertise. The *Daubert* criteria presuppose a level of autonomy on the part of the judge, which is inconsistent with the expertise game's "interactive" and "locationally distributed" nature (Jasanoff, 1998, p. 89; 1995). How legal language may be integrated into the development of objective claims and how justice institutions establish rules of admissibility do not seem to be

taken into account. These gaps lead Jasanoff (1998) to support that *Daubert* did not intend to provide a restricting set of rules for establishing expertise and should not be interpreted as such.

3.9. Objectivity In Regulatory Settings

As previously stated, the law has its own set of rules and methods for determining which evidence is acceptable. These principles may both meet legal requirements and adhere to culturally accepted notions of expert validity (Jasanoff, 2002). Expert claims on specialized knowledge may not be culturally characterized as subjective, as in astrology, or prejudiced, as in the case of plaintiffs' paid witnesses. Credibility is a product of co-production among facticity and experience, or more specifically, of objectivity and professionalism; "credibility can be gained, most commonly through moves that seek to professionalize and objectify the assertions of expert witnesses" (Jasanoff, 198, p. 103).

However, taking again a closer look at *Daubert*, one may encounter a fascinating remark. Out of the four *Daubert* criteria, peer review refers to the moves along the horizontal axis of experience, from personal to professional (Jasanoff, 1998). However, it may also refer to the vertical axis of objectivity.

In fact, Jasanoff suggests that the *Daubert* criterion of peer review is closely linked to objectivity (Jasanoff, 2011b). The expert review has been a component of establishing facts and credibility since the scientific revolution (Shapin and Schaffer, 1985). Robert Merton (1942) later formalized peer review as "organized skepticism," one of the four fundamental science norms. To be certified as a fact, each scientific assertion had to pass the scrutiny of more than one set of watchful eyes; "in the register of experience, the expert shows that her type of knowledge claims is not unique to herself; others with similar experience would look at the situation through similar lenses and come to similar conclusions" (Jasanoff, 2002, p. 50).

As a result, journal editors, grant-making agencies, and regulatory bodies adjusted their peer review, as whoever controlled the peer position would ipso facto control the position from which regulatory science would be certified "as bias-free" (Jasanoff, 2011b).

Commenting on the US policy, Jasanoff suggests that even though the process of peer review has become intensely political, the power of peer review to deliver objectivity has remained unchanged. Peer review acts as a procedure for aligning "government science" with the judgments of the scientific community.

This observation leads us to the conclusion that objectivity is not just a degree of facticity. Objectivity is an epistemic achievement. Jasanoff (2011b, p. 311) suggests that when objectivity "escapes the laboratory," it holds a double role, the one of the legitimator of knowledge and the knowledge maker. This gives answers to the question raised by Collins and Evans (2002) about how regulatory agencies can provide a basis for discriminating between sciences and non-sciences and legitimate and illegitimate forms of expertise, even though their members are not scientists or

judges. The answer is that their knowledge "is constituted by a cluster of highly specialized, routinized, and opaque micro-practices, in which nobody usually intervenes" (Jasanoff, 2011b, p. 310). The making of objectivity takes time and is culturally situated, enacted, and reproduced at multiple sites and organizational levels, or "fields of practice" whose logic and modes of operation reinforce one another (Bourdieu, 1987). Repeated practices, such as regulatory peer review, share the commitment of political culture to a certain kind of objectivity until it becomes a binding standard. When formed, objectivity's cultural meaning persists over time.

Regulatory decisions gain authority while they rest on the epistemic achievement of objectivity (Jasanoff, 2011b). As science for policy demands respect because it invokes the cultural authority of pure science, credibility-enhancing methods are employed to draw challenged assertions back into certified knowledge during regulatory conflicts. This regulatory objectivity is derived from the purification that scientists have historically aimed for in making representations of nature (Latour, 1993; Daston and Galison, 2007).

In practice, the formation of regulatory objectivity involves practices for preserving the judicial review itself (Jasanoff, 2011b). Linguistic repertoires, for example, might be modified to resemble judicial processes so as to reinforce a consistent set of political and ideological beliefs. Precisely staged performances in which assurance and dependability dictate the actions on the front stage, while doubt and uncertainty are relegated to the relative obscurity of the backstage (Hiltgartner, 2000). These processes highly resemble the ritualistic legal procedure so that the expert is linked to the objective truth (Jasanoff, 1998) and the regulatory bodies to the authority of justice institutions.

As a result, national styles of epistemic legitimation constitute their norm of objectivity, which is so deeply entrenched in the social order that it is rarely exposed to scrutiny. Though not universal, a growing number of viewpoints on objectivity are situated so that new perspectives are difficult to emerge. This view of objectivity closely resembles what Thomas Nagel (1986) described as a "view from nowhere" to characterize objective scientific knowledge, distinguishing it from standpoint-based subjective perceptions of reality. Nagel acknowledges that these two points of view can be at odds. However, he does not dismiss the idea of creating more and more objective representations of the world as it is. Along these lines, regulatory objectivity is interactive and locationally distributed, as similarly described in the "expertise game" concerning expertise in legal contexts.

4. Chapter 3: Comparison with Competing STS Approaches

In this chapter, Jasanoff's approach on co-production and the law–science relationship will be critically analyzed in comparison to the competing STS approach of Bruno Latour.

4.1. Social Position of Law and Science

Jasanoff begins examining the law–science relationship by stating that these institutions are institutions of power (Jasanoff, 1995). As each of them underwrites each other's existence, there is a need for balanced research on their practices. This notion entails that both these institutions are (almost) equally social. Equality is not only reflected in her view that vital issues of modernity necessitate collaborative efforts between these two domains and their relative professionals but is best noticed on her statement that societies increasingly define themselves through scientific and legal conflicts (Jasanoff, 1995, p. xiii).

Concerning co-production, even the title *Science at the Bar* does not imply any social inferiority of science to law. Instead, it implies that both institutions are fairly socially equal and that the legal setting (namely court, Bar, etc.) is the forum where science is hosted. Similarly, powerful legal norms can be used in a debate on biological advances, even though the debate itself might concern, for example, human embryonic stem cells (Jasanoff, 2001).

Latour agrees that each of these institutions underwrites each other's existence: "It is also impossible to make a direct comparison between science and law, without first describing those aspects in which each bears features that seem to have come from its counterpart" (Latour, 2010, p. 202). However, he does not share this opinion of the equally social stand of law and science. According to him, science has two "faces"; an outside face concerning how science is socially viewed and an inside face concerning the internal scientific procedures and workings. He aims to penetrate science from its outer encasement of science to its inner workings in order to explain to an outsider how it works-namely, to *socialize science.* In his words, "for sure, many young people have entered science, but they have become scientists and engineers; what they have done is visible in the machine we use (…). How they did it, we don't know." (Latour, 1987, p. 15).

4.2. Co-production

Jasanoff (2007) claims that the historical evolution of science and law has not been distant. They have influenced each other's discourses and prerogatives. The engagements between them remain largely unexamined for traditional frameworks, as scientific and legal progression has been envisaged in isolation from each other. However, today, many critical institutions of modernity demand an ongoing collaboration between the institutions of law and those of science and technology. So, as the traditional boundaries between their relative spheres of influence are at stake, co-production acts as the framework where natural and social orders are produced together and as a means through which modern societies form their epistemic and normative

understandings (Jasanoff, 1995). Co-production as a process is as foundational as constitution-making or state-making in political theory (Jasanoff, 2004).

Latour is, at first, sympathetic towards this stance as he does not presume any a priori demarcations of the world: "Society, as we know, is no less constructed than Nature, since it is the dual result of one single stabilization process" (Latour, 1993, p. 94). Culture divides are creations of human ingenuity, aiming to organize the hybrid networks that make up their cognitive and material existence. These divides shape ostensibly self-contained natural and cultural realms. Latour aims to highlight how "natural" objects (such as the cloned sheep Dolly) and "social" objects (such as experts) function together as "actor-networks."

In these two realms, Latour emphasizes the importance of both material objects and human institutions. He has produced striking observations about the pervasive interdependence of the natural, social, and material worlds; "nature" is the result of solving controversies (1987); the laboratory is a microcosm of larger aggregations of power (1988a), material objects, such as locks and speed bumps, act as "sleeping policemen," capitalism and markets are constructed using the same techniques that scientists use to create convincing representations of nature (1990), and the essence of modernity lies in its dedication to purify these hybrid networks of nature and culture (1993).

4.3. Materialities – Constitutive Co-Production

In the second chapter of *The making of law: An ethnography of the Conseil d'Etat* Latour (2010) offers a case study of co-production involving materialities. When examining the death of a young man at a ski center, he suggests that if his death had not been turned into an articulated complaint, then none of these scattered papers (certificates, maps, meteorological bulletins, and invoices) would have counted as pieces of evidence in the legal sense. Their role would have remained the same even if they were disseminated or stored. Therefore, these standard components have taken on a legal shape. This transformation took place *retroactively*, as evidence has been mobilized "in the claim and because of the accident itself" (Latour, 2010, p. 77). Hence, one can refer to this case as a co-production of claims and evidence.

Nonetheless, concerning co-production, Latour's essay does not restrict itself to the "material realm," but it evolves into more sophisticated forms. For example, though without intention, Latour consider the Branch of the Conseil d'Etat to be responsible for editing the state decrees as a product of co-production between the government and the judicial power. Conseil d'Etat members are at once counsels and censors of the administration, meaning they also take on the extra responsibility of teaching the government due to their alternation between these two duties.

Jasanoff (2004) considers the above views on exposing the constructed character of the nature-culture boundary of Latour to be representative of a specific tradition of co-production,

which she calls *constitutive co-production.* The French school of actor-network theory has heavily influenced this tradition. This perspective of co-production grants agency to non-humans and emphasizes the role of the material and the inanimate in constituting social order. In Latour's accounts, mechanical agents frequently serve as surrogates, to whom humans have chosen to delegate some of their agency. In her words, that form of co-production is "more material and less idealistic than that of many Anglo-American scholars writing outside the Marxist tradition" (Jasanoff, 2004, p. 22).

Emphasis on materialities is not something out of the co-production framework of Jasanoff: "Co-production is not about ideas alone; it is equally about concrete physical things" (Jasanoff, 2004, p. 6). Jasanoff claims that courts offer distinctive institutional competencies to construct the relationship between material objects and social needs, and both characteristics should be addressed in a fair evaluation of their performance (Jasanoff, 1995). Also, in *States of Knowledge* (2004, p. 2), she supports that "knowledge and its material embodiments are products of social life; society cannot function without knowing any more than knowledge can exist without appropriate social supports."

One may claim that Jasanoff's analysis of the material throughout her work is limited, as she tends to emphasize the institutionalized contexts and ways of knowing (Jasanoff, 2001). Moreover, according to her words, "co-production could hardly be conceived out of institutions" (Jasanoff, 2004, p. 40).

Although Jasanoff at least recognizes the persuasiveness of Latour's remarks, she comments that they dismiss the moral and political tensions that frequently accompany the development and maintenance of governing systems. For example, Latour says little about why some actor-networks remain contested and unstable for long periods while others settle quickly or about the roles that memories, beliefs, values, and ideologies play in sustaining some representations of nature and the social world at the expense of others, or why the credibility of scientific claims varies across cultures (Jasanoff, 2004).

4.4. Analysis perspective

Jasanoff (2007) highlights that "STS analysis of law-science interactions has tended to focus on in-depth studies of individual cases or institutions rather than on varying practices across cultures or political systems" (p. 779). Similarly, *in the States of Knowledge (2004),* co-production may help identify "deep cultural regularities" that allow such explanations and predictions. In that sense, she is judgmental of Latour's ethnographic research on Conseil d' Etat, commenting that the focus on the French administrative and judicial practices cannot lead to conclusions on legal epistemology, rather than on the factors that make "the Conseil d' Etat's institutions about facticity and legality specifically French" (Jasanoff, 2007, p779). Her research is focused on the "macro" perspective.

Latour (2010) acknowledges the locality of law; "law is provincial, so stubbornly local" (p.vi). So, as an ethnographer, he deciphers "the essence of law" through his extensive research on French administrative law. His essay is so specific that he states that "in that book that follows, everything is just as exotic to most French-speaking readers as it is to English-speaking readers" (p. vii). His research aims to the "micro" perspective.

In her essay *The Practices of Objectivity in Regulatory Science* (2011b), Jasanoff compares objectivity and public knowledge in different cultural and political settings. She concludes that:

- In Britain, advisory commissions are frequently associated with a distinguished chairman, as their virtue is thought to legitimize the process. Apart from their status, these elite figures convey a commonsense vision: Anyone in society may attest to the veracity of this information. As a result, objectivity based on a community perspective emerges.
- In Germany, expert bodies produce knowledge through collective reasoning that is expressly founded on political representation principles, neutral deliberative spaces, and flawless communication. The inclusion of all legitimate points of view is the one conferring epistemic authority.
- In the USA, scientific data is used to explain government choices, and there is a far more divided discussion regarding the quality of scientific and technology judgments. Objectivity exists an impersonal space (Jasanoff, 2005a), divorced from social standpoints, impersonal purity, and social detachment (Jasanoff and Ulgen, 1985).

These findings are based on specific institutions. However, the conclusions drawn concern the varying practices across legal jurisdictions on a macro scale. In that spectrum, one may argue that Jasanoff's critique of *The Making of Law: An Ethnography of the Conseil D'Etat* is unduly harsh. In-depth analysis on specific institutions is not of no use, as it offers the very foundation of the research on varying practices.

Through his journey, Latour examines a series of differences between courts and laboratories, namely the meaning of public and private, the use of space, ethology, dress code, speak and gestures of their members, equipment. Not only that, but he finds social meaning in logos and paintings, pieces of furniture, files, and telephones. In his words, "[every part of a legal document] has already undergone a long history which for the most part escapes the ethnographer as well as the counselors, but whose traces can be recognized at first sight from the type of letter headed paper, from the presence and name of some famous and expensive lawyer's firm, from the manner of writing and the greater or lesser display of legal knowledge, texts of laws and decrees and learned words taken from Molière" (Latour, 2010, p. 73). Though specific, given the influence of the French administrative, legal system, throughout mainland Europe, these remarks are not

relevant only to the French social order. So, one wonders whether Latour's research is indeed restrictively specific or focused on a different level of perspective.

4.5. Identities

Latour (1987) suggests that the best way to understand the scientific enterprise is to "follow scientists and engineers through society." On the other hand, Jasanoff (2007) comments that this injunction has been proven much more complex in practice.

She accepts that each institution shores the other's status since scientists are seen as the most competent commentator on science and lawyers on the law. However, should one perseveringly keep following the trail of scientists (and engineers), they will notice that they are likely to appear in areas not of their traditional reach. Following scientifically trained professionals through their "working spaces" may lead to places out of science, as not each of their actions is per se scientific. As mentioned in the defendant's response videotape in *Silicone Gel Breast Implant Litigation* of 1996, "The fact that a scientist wants to speak does not mean that the words he speaks are supported by science" (Jasanoff, 1998, p. 100).

Additionally, according to Jasanoff (2007), following the practitioners in either domain is necessarily limited. Scientists and lawyers move about in their professional worlds following well-established conceptions of their roles and goals. Even reflexivity, a part of each institution's thought models, operates within circumscribed interpretive conventions.

Latour fully acknowledges this aspect; "there is an immense difference, very easy to grasp, between speaking about law and speaking legally" (Latour, 2010, p. ix). However, the practice of implementing the law is what he calls "the essence of law" (Latour, 2010, p. x). Further, he adds that "knowing that an essence does not lie in a definition but in practice, a situated, material practice that ties a whole range of heterogeneous phenomena in a certain specific way. And it is on the search for this specific way that this book is entirely focused" (Latour, 2010, p. x).

4.6. Courts in Practice vs. Institutions of Justice

Considering their different views on the social stance of science and their analysis' perspective, Latour and Jasanoff follow different routes on examining the implementation of justice.

Latour treats how courts administer justice *in practice* as a springboard. He does not attribute to them any neutrality per se. Instead, he maintains that a legal system can be unfair. Furthermore, any external influence is part of how the law gets implemented *in practice.* Even the judges' position can be at stake if they become too troublesome to the government (Latour, 2010).

He is not hesitant to comment on courts' unfamiliarity with contemporary science as a social institution (Latour, 2010). He specifically observes that judges can be uncertain, resistant,

and skeptical of quantitative methodologies and scientific concepts, such as causality, probability, and statistical significance; also, courts seem unfamiliar with how scientific credibility is produced through complicated negotiations within the relative community with external institutions.

On the other hand, Jasanoff portrays courts in an achromatically neutral template. They aim to establish justice and solve disputes with fairness, seeking truth. In instances of courts being swayed by external influences or occupied by adversarial zeal, it does not follow that they are not engaged in finding the truth. Political influence, or even the possibility that this could occur in the first place, signifies an aspect of the political culture. "Litigation is too pervasive a feature of a political culture" (Jasanoff, 1995, p. 206). That may be attributed to Jasanoff not granting agency to institutions but only to humans. An extensive analysis of how external influences directly affect court decisions may very well fall under the "crisis" narrative concerning the relationship between science and law.

The above notions explain the different views they hold on the efficiency of courts; "there is nothing superior to the supreme court. Above this somewhat derisory institution, there is nothing better, quicker, more efficient, more economical and, above all, nothing that would be more just" in Latour (2010, p. 69) versus "[c]ourts have proven remarkable for their resiliency and adaptability. Indeed, it is not much to assert that the judicial system and the law have provided the framework for the orderly adaptation of many aspects of life to modernization, political evolution, and cultural change" in the "Foreword" of *Science at the Bar* (1995, p. ix).

It is worth mentioning that both Latour (2010) and Jasanoff (1998) deal with judges' personal experiences, influencing how they handle legal cases and impose the law.

4. 7. Matters of Authority

Unraveling the relationship between science and law, Latour (2010) states that:

> Both domains emphasize the virtues of a disinterested and unprejudiced approach, based on distance and precision; in both domains, participants speak esoteric languages, and they reason in carefully cultivated modes; both scientists and judges seem to attract a kind of respect that is unknown in other human activities. (p. 198).

Contrary to the authority a scientifically trained professional can have, due to the ambiguity of their research, Jasanoff (1998) pictures the authority of legal professionals as almost even; instead, in a legal setting, the credibility of experts is granted (Jasanoff, 1990).

In contrast, Latour (2000) figures that authority in law is not universal. Even academic professionals of law may be disputed: "Counselors rarely cite academics or Professors of administrative law, whose presence, from the point of view of the Council, seems purely explicative and even parasitical" (p. 13). Thus, even a legal branch can struggle for authority.

5. Conclusion

Many of the defining characteristics of contemporary societies can be attributed to science and technology (Williamson, 2019). On the other hand, even if it seems absent on the surface, the law constrains the language in which such scientific and technological discussions are framed (Jasanoff, 2001; 2011a). As societies define themselves through scientific and legal conflicts, courts are often the first to host formerly inaudible debates (Jasanoff, 1995). Until today, scientific and legal progression has been envisaged in isolation from each other to a considerable degree. However, vital issues of modernity necessitate collaborative efforts between these two domains and their relative professionals (Jasanoff, 1995).

One of the main goals of STS studies has been to demonstrate that our understanding of science and technology is generated and solidified by socially sanctioned systems of discourse and practice. Jasanoff (2007) suggests we "go beyond close readings" of following separate ways to research science, technology, and law to comprehend the dynamics between these two institutions. Co-production is the framework in which one can fully acknowledge how modern societies form their epistemic and normative understandings without being deprived of depth or sophistication (Jasanoff, 1995). "At issue, after all, is not only how scientists produce facts for legal use but also how science supports ideas of causality, reason, and justice in law." (Jasanoff, 2007, p. 761).

Co-production escapes technological and social determinism and unravels the law–science relationship symmetrically since each institution underwrites each other's existence in ways that have previously escaped systematic analysis (1995). STS researchers have mainly examined the interaction between these in institutions by focusing on examining the making of specific bodies of knowledge within the law, such as patents (Biagioli, 2006), fingerprinting (Cole, 2001), and DNA profiling (Lynch et Jasanoff, 1998). However, the co-production idiom aims to provide a deeper understanding of scientific changes and institutional knowledge-making.

Suppose one perseveringly keeps reviewing the law-science relation, they will apparently survey each tradition's approach to facts. Jasanoff (1995, p. 9) claims that both institutions share common aims in fact-finding since science is concerned with obtaining the "right" facts ("at least to the extent permitted by the existing research paradigm or tradition"). Moreover, the law also aims to establish facts "correctly" to handle conflicts with fairness. Finding the "right" facts, namely truth itself (Shapin, 1994) and objectivity, have long been a central issue in the philosophy of knowledge (Rorty, 1991).

Objectivity partakes of the neutrality and impartiality of science itself (Jasanoff, 2011b). Since many critical issues of modernity necessitate collaborative efforts between law and science, increasingly more commitments have been made to justice institutions to cloak their judgments with the "objective" authority of scientists, technology experts, and their relative instruments (Jasanoff, 1995).

However, objectivity in a legal setting cannot be viewed as a representation of nature. Even if context-specific, deterministically value-neutral, objective, and not socially constructed scientific claims existed, courts could not rely on them as they have their own rules and practices for choosing admissible evidence. Judicial ideas of rationality stand above and beyond any tests derivedfrom science's repertoire of legitimation (Jasanoff, 2002), as articulated "in the *Daubert* and *Kumho* decisions". Therefore, any formulaic methods on admissibility fail to account for the uncertainties that govern the production of scientific knowledge (Jasanoff, 1995).

As expertise is formed in engagements between science and law, clarification must be sought in a co-production spectrum within the context of evidence production. Moreover, evidence is a hybrid product of legal and scientific reliability criteria aimed to contribute to knowledge-making in legal contexts.

The "expert making" process is graphically portrayed by Jasanoff (1998) as a "game." Two imaginary axes divide the imaginary expertise board into four quadrants. Together, they define the spaces in which expertise can be asserted or challenged. The horizontal axis—labeled “experience”—accommodates moves designed to professionalize expert witnesses' knowledge claims. Experts must embody the collective judgments of a field, occupation, or profession to be recognized as such. The vertical axis—labeled “objectivity”—designates efforts to move expert evidence from the pole of untested or subjective observation (e.g., eyewitness testimony) towards that of scientific fact. The closer an expert testimony adheres to scientific norms, the more the weight that it carries.

Individuals must push their claims toward scientific objectivity and verified professional expertise. Because the authority of both science and law depends on appeals to transcendental truths, no expert can allow themselves to be perceived as subjective, arbitrary, or entangled in the particularities of individualism (Jasanoff, 2007).

As a result, credibility is a product of co-production of facticity and experience, or more specifically, of objectivity and professionalism: "Credibility can be gained, most commonly through moves that seek to professionalize and objectify the assertions of expert witnesses" (Jasanoff, 1998, p. 103). This view is closely linked to "a new envision of expertise, a fairly flexible hierarchy of expertise, perhaps best suited to public science controversies," as Lynch and Cole (2005, p. 296) have described. Moreover, as courts aim to produce localized and context-specific solutions to disputes brought before them, expertise in legal settings is formed interactively by multiple parties and is locationally distributed, not being subordinated to inappropriately universal standards. Winning methods frequently include purposeful linguistic repertoires, stage performances, and adaptation to choices made by other players claiming higher scientific or professional authority (Jasanoff, 2002).

However, objectivity is not just a degree of facticity. Jasanoff (2011b, p. 311) suggests that when objectivity "escapes the laboratory," it holds a double, the one of the legitimator of

knowledge and the knowledge maker. Objectivity is a hard-won epistemic achievement; in regulatory contexts, regulatory decisions gain authority as they rest on the epistemic achievement of objectivity (Jasanoff, 2011b).

The formation of regulatory objectivity involves practices for preserving the judicial review itself and is constituted by "a cluster of highly specialized, routinized, and opaque micro-practices, in which nobody usually intervenes" (Jasanoff, 2011b, p. 310). The making of objectivity takes time and is culturally situated, enacted, and reproduced at multiple sites and organizational levels, or "fields of practice" whose logic and modes of operation reinforce one another (Bourdieu, 1987). Repeated practices, such as regulatory peer review, share the commitment of political culture to a certain kind of objectivity until it becomes a binding standard, so new perspectives are difficult to emerge. Along these lines, regulatory objectivity is interactive and locationally distributed, as similarly described in the "expertise game" concerning expertise in legal contexts.

This view of objectivity closely resembles what Thomas Nagel (1986) described as a "view from nowhere" to characterize objective scientific knowledge, distinguishing it from standpoint-based subjective perceptions of reality. The "view from nowhere" stands as a sense of *inter-subjectivity*, as distinguished by Psillos (2007).

The co-production literature links objectivity, reliability, and expertise to the legitimation of science and technology. It aims to re-integrate objectivity and subjectivity (and indeed intersubjectivity) into explanatory projects that are closely related to the modern social order.

Not straightly related to this thesis, but undoubtedly worth mentioning is that Jasanoff (2004) associates the notions of objectivity, reliability, and expertise to the constitution of democratically accountable political regimes. According to her, objectivity presupposes the presence of a shared reality against which free individuals can evaluate the performance of their elected officials.

Jasanoff (2011b) suggests objectivity is best understood in a framework of controversy where opposing actors challenge one another's assumptions and reveal the interpretative flexibility of their notions. To controversy, she adds *comparison* across space, time, and actors for universal epistemic norms to be deciphered. In her words, "One of the greatest strengths of legal proceedings is precisely the ability to produce localized, context-specific epistemological and normative understandings that are not subordinated to inappropriately universal claims and standards" (Jasanoff, 1995, p. 222). In that spectrum objectivity is neither reduced to relativism nor determined employing "unambiguous rules applied impartially and without variance by Solomonic judges" (Jasanoff, 1998, p. 103).

Interestingly, Latour portrays the comprehension of objectivity in a *controversial* framework as well: "Being objective means that no matter how great the efforts of the disbelievers to sever the links between you and what you speak for, the links resist—being subjective means

that when you talk in the name of people or things, the listeners understand that you represent only yourself" (Latour, 1987, p. 78).

Although these researchers both critique realism, they follow separate approaches in examining the law–science relationship, they hold separate views on the social hold of each tradition, grant agency to different aspects, and focus on different perspectives. Jasanoff's research is focused on the "macro" perspective, trans-national epistemology, and institutions. On the other hand, Latour follows a "micro" perspective, as he aims to find the "*essence of law",* meaning where it gets implemented *in practice* and is interested in empirical experience.

All in all, Jasanoff's review of Latour's work is summarized in the following statement: "analysis of single actors, institutions, or events can provide micro-insights into particular knowledge controversies and exercises of epistemic power. But to understand something as pervasive and of *longue durée* as the norm of objectivity in a regulatory culture, we need to adopt a sidelong gaze from alternative temporal and spatial worlds" (Jasanoff, 2011b, p. 336).

References

Ayala, F., & Black, B. (1993). Science and the Courts. *American Scientist, 81*(3), 230-239. Retrieved August 22, 2021, http://www.jstor.org/stable/29774918

Angell, M. (1996). *Science on Trial: The Clash of Medical Evidence and the Law in the Breast Implant Case*. New York: Norton.

Bourdieu, P. (1980). Pierre Bourdieu: a bibliography. Media, Culture & Society, 2(3), 295–296. https://doi.org/10.1177/016344378000200306

Bourdieu, P. (1987). *The Force of Law: Towards a Sociology of the Judicial Field*, translated by Richard Terdiman. Harvard Law Review 91: 1833-45.

Caudil, D. & Redding, R. (2000). *Junk Philosophy of Science? The Paradox of Expertise and Interdisciplinarity in Federal Courts,* Washington and Lee Law Review 57: 685 – 766.

Collins, H. M., (1998). *The Meaning of Data: Open and Closed Evidential Cultures in the Search for Gravitational Waves*, *American Journal of Sociology*, 104, 2, 293-337.

Collins, H. M., & Evans, R. (2002). *The Third Wave of Science Studies: Studies of Expertise and Experience.* Social Studies of Science, 32(2), 235–296. https://doi.org/10.1177/0306312702032002003

Daston, L., & Galison, P. (2007). *Objectivity*. New York: Zone Books.

Federal Judicial Center (1994). *Reference Manual on Scientific Evidence, First Edition* (superseded),

Fuller, F. (1969). Concerns of teachers: Developmental conceptualization. *American Educational Research Journal, 6*, 207-225.

Gieryn, T.F. (1995). Boundaries of science. In Handbook of Science and Technology Studies, ed. S Jasanoff, G Markle, J Petersen, T Pinch, pp. 393–443. Thousand Oaks, CA: Sage.

Gieryn, T. F. (1999). *Cultural boundaries of science: Credibility on the line*. Chicago: University of Chicago Press.

Goldberg, S. (1994). *Culture Clash*. New York, USA: New York University Press. https://doi.org/10.18574/9780814733486.

Habermas, J. (1975). Habermas, J. (1975). *Legitimation crisis*. Boston: Beacon Press.

Hacking, I. (1999). *The Social Construction of What?* Cambridge, Massachusetts; London, England: Harvard University Press. doi:10.2307/j.ctv1bzfp1z

Harr, J. (1995). *A civil action*. New York: Random House

Hartouni, V. (1997). *Cultural Conceptions: On Reproductive Technologies and the Remaking of Life*. University of Minnesota Press. Retrieved August 13, 2021, from http://www.jstor.org/stable/10.5749/j.cttth3v

Hermitte, M. –A. (1996). *Le Sang et le Droit, Essai sur la Transfusion Sanguine, Paris, Seuil.*

Hess, D. and Sovacool, B. (2020). *Sociotechnical matters: reviewing and integrating science and technology studies with energy social science.* Energy Research & Social Science, 65. a101462. ISSN 2214-6296

Hilgartner, S. (2000). *Science on Stage: Expert Advice as Public Drama,* Stanford: Stanford University Press.

Hoeyer, K. (2004) *Ambiguous gifts: public anxiety, informed consent and biobanks*. In Tutton R, Corrigan O (Eds) Genetic Databases: Socio-Ethical Issues in the Collection and Use of DNA. London: Routledge.

Huber, P. (1991). Galileo's Revenge: Junk Science in the Courtroom. New York: Basic Books.

Jasanoff, S. (1990). *The Fifth Branch: Science Advisers as Policymakers.* Cambridge, Massachusetts: Harvard University Press.

Jasanoff, S. (1995). *Science at the Bar: Law, Science, and Technology in America.* Cambridge, Massachusetts: Harvard University Press.

Jasanoff, S. (1998). `Expert Games in Silicone Gel Breast Implant Litigation', in Michael Freeman & Helen Reece (eds), Science in Court (London: Dartmouth): 83-107.

Jasanoff, S (2001) Image and imagination: The formation of global environmental consciousness. In: Miller, C, Edwards, P (eds) *Changing the Atmosphere: Expert Knowledge and Environmental Governance,* Cambridge: MIT Press, p. 309–337.

Jasanoff, S. (2004). The Idiom of Co-production. In: Jasanoff, S *(ed)* States of Knowledge: The Co-Production of Science and Social Order. Routledge Taylor & Francis Group. Copy at http://www.tinyurl.com/y4hjw5ws

Jasanoff, S. (2004). Ordering Knowledge, Ordering Society In: Jasanoff, S *(ed)* States of Knowledge: The Co-Production of Science and Social Order. Routledge Taylor & Francis Group. Copy at http://www.tinyurl.com/y4hjw5ws

Jasanoff, S. (2005). *Designs on Nature: Science and Democracy in Europe and the United States.* Princeton: Princeton University Press.

Jasanoff, S. (2007). *Making Order: Law and Science in Action."*The Handbook of Science and Technology Studies, Third Edition. Ed. Edward J. Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wajcman. MIT Press.

Jasanoff, S. (ed.) (2011a). *Reframing Rights: Bioconstitutionalism in the Genetic Age.* Cambridge, Massachusetts: MIT Press.

Jasanoff, S. (2011b) *The Practices of Objectivity in Regulatory Science,* in C. Camic, N. Gross, and M. Lamont, eds., *Social Knowledge in the Making* (Chicago: University of Chicago Press, 2011), pp. 307-337.

Jasanoff, S. (2019). *Can Science Make Sense of Life?* Cambridge. Massachusetts: Polity

Jasanoff, S. and Ilgen, T. (1985). Controlling chemicals: The politics of regulation in Britain and the United States. Ithaca, NY: Cornell University Press.

Jasanoff, S. and Wynne, B. (1998) `Scientific Knowledge and Decision Making', in S. Rayner and E. Malone (eds) Human Choice & Climate Change, 4 vols, pp. 1-112. Columbus, OH: Battelle Press.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society.* Cambridge, Massachusetts: Harvard University Press.

Latour, B. (1988). *The pasteurization of France*. Cambridge, Mass: Harvard University Press.

Latour, B. (1993). *We Have Never Been Modern*. Harvard University Press.

Latour, B. (2005a). *Reassembling the Social: An Introduction to Actor-Network-Theory.* Oxford: Oxford University Press.

Latour, B. (2010). *The making of law: An ethnography of the Conseil d'Etat*. Cambridge, UK: Polity.

Latour, B. & Woolgar, S. (1979). *Laboratory life: The social construction of scientific facts*. Beverly Hills: Sage Publications.

Latour, B. & Woolgar, S. (1986). *Laboratory Life: The construction of scientific facts*. Princeton University Press.

Lazer, D. (2004). *DNA and the Criminal Justice System: The Technology of Justice.* Boston, MA: The MIT Press.

Leclerc, O. (2005). *Le juge et l'expert. Contribution à l'étude des rapports entre le droit et la science,* préface Antoine Lyon-Caen, L.G.D.J,

Lieberman, L. M. (1981). *A Significant Destructive Attitude.* Journal of Learning Disabilities, 14(9), 550–551. https://doi.org/10.1177/002221948101400912

Lynch, M., & Cole, S. (2005). *Science and Technology Studies on Trial: Dilemmas of Expertise. Social Studies of Science, 35(2),* 269-311. Retrieved August 14, 2021, from http://www.jstor.org/stable/25046642

Merton, R. K. (1942). "Science and technology in a democratic order," *Journal of Legal and Political Sociology*, 1, pp. 15–26.

Milroy, C. M. (2017). *A Brief History of the Expert Witness*. *Academic Forensic Pathology*, *7*(4), 516–526. https://doi.org/10.23907/2017.044

Nagel, T. (1986). *The view from nowhere*. New York: Oxford University Press.

Ogburn, W. F. (1957) Papers, [Box 42, Folder 49], Hanna Holborn Gray Special Collections Research Center, University of Chicago Library.

Peine, A., & Neven, L. (2019). From Intervention to Co-constitution: New Directions in Theorizing about Aging and Technology. *The Gerontologist*, *59*, 15–21.

Pickering, A. (1996). *The Mangle of Practice: Time, Agency, and Science.* Bibliovault OAI Repository, the University of Chicago Press. 38. 10.2307/3106908.

Psillos, S. (1999). *Scientific Realism: How Science Tracks Truth.* London: Routledge.

Psillos, S. (2007). *Philosophy of science A-Z.* Edinburgh University Press.

Rorty, Richard (1990). *Objectivity, Relativism, and Truth: Volume 1: Philosophical Papers.* Cambridge University Press

Sage, W., Kersh R. (2006). *Medical Malpractice and the U.S. Health Care System*. New York: Cambridge University Press.

Schuck, P. (1986) "The Role of Judges in Settling Complex Cases: The Agent Orange Example," *University of Chicago Law Review*: Vol. 53: Iss. 2, Article 4. Available at: https://chicagounbound.uchicago.edu/uclrev/vol53/iss2/4

Schuck, P. (1993). *Public Law Litigation and Social Reform,* 102 YALE L.J. Available at: https://digitalcommons.law.yale.edu/ylj/vol102/iss7/7

Shapin, S. (1994). *A Social History of Truth: Civility and Science in Seventeenth-Century England*. University of Chicago Press.

Shapin, S., & Schaffer, S. (2011). *Leviathan and the air-pump: Hobbes, Boyle, and the experimental life*. Princeton, N.J: Princeton University Press.

Smith, M. R., & Marx, L. (1994). *Does technology drive history?: The dilemma of technological determinism*. Cambridge, Mass: MIT Press.

US Supreme Court (1996), Brief of Amici Curiae, in the *New England Journal of Medicine*, and Marcia Angell MD, in Support of Neither Petitioners Nor Respondents, *General Electric Co. v. Joiner* No. 96-188.

van Kampen, P. T. C. (1998*). Expert evidence compared: rules and practices in the Dutch and American criminal justice system.* Antwerpen: Intersentia.

Vidmar, N. (1995). Medical Malpractice and the American Jury: Confronting the Myths about Jury Incompetence, Deep Pockets, and Outrageous Damage Awards, Michigan: Michigan University Press.

Williams, B. (1985). *Ethics and the Limits of Philosophy.* London: Fontana.

Williamson, B. (2019). *Digital policy sociology: Software and science in data-intensive precision education. Critical Studies in Education*, 1-17. https://doi.org/10.1080/17508487.2019.1691030

Woolgar, S. (Ed.). (1988). *Knowledge and reflexivity: New frontiers in the sociology of knowledge.* Sage Publications, Inc.

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