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***Wissenschaftsreflexion*: What is it? What is the need for it?**

Contemporary challenges for studies in science

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Abstract

Academic freedom and societal respect for science have been decreasing in the past years in the wake of growing nationalism, authoritarianism, and fundamentalism. Even in liberal democracies, science has been attacked by anti-science movements. One of the reasons for the weakening credibility of scientific knowledge is its exaggerated use in framing policy questions. Conflicts about interests and values are transformed into controversies about the validity and relevance of studies and data. Since scientific knowledge is a foundation of liberal democratic knowledge societies, a refusal to recognize it as a legitimate basis of decision-making undermines democratic deliberation and societal participation. We propose *Wissenschaftsreflexion* as a specific approach to addressing the challenges posed by the influence of science on political and social affairs and the unfavorable response to this influence by parts of developed knowledge societies. *Wissenschaftsreflexion* is integrative in collaborating with the various home disciplines of the humanities and the social sciences, and explicitly normative in judging the conditions and limitations of scientific advice and in taking liberal democracies as the basis of rational, fact-based policy decisions. The academic system alone cannot defend the appropriate use of scientific knowledge against unfounded threats. Attacks should be recognized as a general societal and political challenge and not be treated as merely a concern of scientists and the science system. Scientific knowledge, scholarship, and the science system need to be protected against unfounded assaults to be able to fulfill the societal tasks assigned to them in liberal democratic knowledge societies.

Keywords Knowledge society · Attack · Research approach · Epistemic judgment · Liberal democracies

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Science under attack

Academic freedom has come under pressure in recent years because of growing illiberalism in the form of nationalism, authoritarianism, and fundamentalism (Lerch et al. 2024: 111). Such constraints are not exclusive to authoritarian states: "The global trajectory of illiberalism has an impact on academic freedoms across the globe" (Lerch et al. 2024: 111). Even in liberal democracies, attacks on science have increased enormously. Anti-science movements, misinformation, and conspiracy theories are examples of such assaults (Fuller 2018; Bromley et al. 2020; Dentith 2022; Harjuniemi 2022; Prasad 2022). In 2017, Cole proposed that academic freedom be regarded as an indicator of a liberal democracy and attacks on science be viewed as threats to liberal democracies (Cole 2017: 863). Attacks on academic freedom, on scientific knowledge, and sometimes on the science system as a whole are not just an academic problem: they challenge liberal democracies.

These attacks are surprising, given that contemporary societies have evolved into knowledge societies in which science and scientific knowledge are widely recognized as a rational basis for decision-making. Indeed, substantial empirical evidence has supported this assumption for several decades. This applies to politics, but also to society at large. Macrosociological studies have demonstrated that science has been welcomed by institutions involved in grassroots participation, civic engagement, human rights, and international organizations (Schofer and Meyer 2005; Schofer et al. 2021). These studies have characterized the societal advancement toward knowledge societies as a global process leading to a liberal international order (Börzel and Zürn 2021).

It is noteworthy that this expansion of science into society at large has met with resistance. While scientific knowledge and higher education became central to nearly all aspects of life and to the majority of advisory systems and global institutions, counter-movements emerged that sought to discredit academic elites and knowledge societies (Burke 2012). Authors who had previously demonstrated empirically that the development of knowledge societies contributes to the globalization of democratization and liberalization have now shifted their investigative focus to illiberal reactions to science and higher education (Schofer et al. 2022). They emphasize the opposition to "the model of society built around individual knowledge, rights, and competences" (Schofer et al. 2022: 510), as well as to knowledge societies and their primary driver, scientific knowledge. In response to the claim that the preeminence of academic knowledge is diminishing (Frank and Meyer 2020: 106), these research approaches now examine how scientific knowledge is contested and how its legitimacy is called into question (Cole et al. 2023).

Some observers may recognize these attacks as the dark side or even the end of the era of knowledge societies (Füssel 2021: 139). We want to explore whether the opposite assumption is true and examine whether the critical response to scientific knowledge and the critical attitude toward scholars that emerges from broader segments of society are indicators of how profound the social impact of scientific knowledge is perceived to be (Barlösius 2024). In this sense, the increased distancing of parts of society from science illustrates how central such knowledge is thought to be as regards political issues. The escalating assaults on science elucidate the social

struggles over the status of the science system in knowledge societies. Accordingly, the two sides of knowledge societies belong together: scientific knowledge is widely received and contested at the same time. This tension gives rise to analytical and normative research questions—for example, which conflicts are prompting the current attacks? What cognitive and affective attitudes toward science are contributing to these confrontations? Are the attacks mainly directed against scientific knowledge or its use for political and social purposes?

This study aims to analyze how the two sides of knowledge societies present novel challenges for the studies of science, as well as for the science system and, in particular, for liberal democracies. The purpose of this article is to introduce the concept of *Wissenschaftsreflexion* as a promising new approach to the aforementioned challenges. This approach is integrative rather than merely interdisciplinary; it is explicitly normative in nature and aims to explore epistemic and political challenges arising from the fact that liberal democracies are dependent on well-founded knowledge.

In the following sections, we first explain how the current attacks on science differ from past attacks and why previous responses are no longer sufficient. We then address the question of whether the attacks are actually directed against science and whether it has thus come under societal pressure. Thereafter, we enter into *Wissenschaftsreflexion* and develop a specific research approach regarding science in society and society in science. We first outline its integrative character and then explain its normative stance. After positioning our research approach in relation to established fields of research, we conclude how *Wissenschaftsreflexion* should be practiced in developed knowledge societies.

Merton's response faced with today's attacks

Academic freedom is not under attack for the first time. In 1942, during World War II and the Nazi regime, Robert K. Merton stated that “science is not immune from attack, restraint, and repression” (Merton 1942/1973: 267). He warned that “local contagions of anti-intellectualism threaten to become epidemic” (Merton 1942/1973: 267) and observed that the science system was under growing political pressure. At first glance, his diagnosis was similar to that regarding the current attacks. Merton responded to these challenges with his essay on the “normative structure of science” (Merton 1942), which he used to explain the ethos of modern science in terms of four norms: universalism, disinterestedness, organized skepticism, and communalism (which came to replace Merton’s term “communism”). Universalism requires that scientific justification be determined according to pre-established impersonal criteria. Disinterestedness means that the scientific community ought to check each result with equal severity. Organized skepticism says that scientific inquiry should not shrink from powerful societal institutions. Communalism means that scientific knowledge is not private property and should not be sequestered by patents. According to Merton, these four norms (in addition to consistency and empirical adequacy) characterize the scientific enterprise and should be implemented in a self-organized way. Accordingly, his approach presupposed or demanded, respectively, that science can operate relatively independently as a social system in liberal democracies and

can defend academic freedom on its own. Merton was convinced that if researchers committed themselves internally to observing the four norms, external attacks could be mitigated effectively.

The current attacks on science are in a way both similar to and somewhat different from those in Merton's time. In authoritarian states, the autonomy of science is once more under political pressure. A period of relatively great academic freedom worldwide during the 1990s has been followed by a phase in which science is again subject to tightened state restrictions (Kinzelbach et al. 2023; Lerch et al. 2024). As Merton pointed out for the 1930s and 1940s, a correlation exists between authoritarian states and restrictions on scientific freedom, while liberal democratic states prove to be guarantors of academic freedom (Berggren and Bjørnskov 2022; Ivancheva 2022; Lai 2023).

Unlike the situation in Merton's time, the case today is that science has also been a target *within* liberal democratic states for some years, and especially in developed knowledge societies. Some of the attacks can be traced back to violations of Merton's norms in research practice. In many cases, research has pursued biased interests and has lacked the necessary skepticism (Oreskes and Conway 2011). It is obvious that patenting and the privatization of knowledge are in full swing. However, this use of scientific knowledge does not explain the dramatic surge of anti-science movements and attacks on science after the turn of the millennium. In order to understand such opposition, it is essential to examine it in its broader social context. Science and society are much more interwoven in knowledge societies today than they were in Merton's time, and are likely to become more so in the future. Nearly all social systems now depend on scientific knowledge. Societal, economic, and political demands are increasingly embedded in the science system through processes such as knowledge transfer, innovation, and the reduction of social and cultural barriers to science. Moreover, knowledge societies are characterized by a distinctive typology of socio-political conflicts and polarization compared to industrial societies in the mid-twentieth century. Responding to attacks on science in liberal democratic knowledge societies needs more comprehensive responses than in Merton's time. The responses should address science and society equally, for the confrontations especially flare up when science is used, or perceived to be used, for political or societal purposes. It is not enough to analyze these confrontations primarily from the viewpoint of the science system. Perspectives from other social systems and society at large also need to be considered in probing the reasons, motives, and exasperated disgruntlement underlying the conflicts.

Science under societal pressure or not?

The attacks against science are manifold, and it is crucial to pinpoint their targets. On the one hand, they might express skepticism toward scientific knowledge; on the other hand, they might be directed primarily against other social systems and only derivatively against the science system. We use the two examples of conspiracy theories and anti-science movements since they are suitable to probe the political or epistemic motives underlying such social movements.

For some years now, scholars have been conveying growing alarm about conspiracy theories (Harambam et al. 2022), which seem to be more popular and influential than ever. While public discourse assumes that conspiracy theories are fundamentally opposed to science, such theories do not usually challenge the justification of the scientific enterprise as such (Butter 2014; Butter 2023; Rao and Greve 2024). What their purveyors do instead is claim that institutionalized scientists and generally acknowledged experts do not produce accurate scientific knowledge or actively promote the agenda of the political elites, and as a result, scientists and experts tend to make misleading statements. Studies show that neither scientists nor experts, but media and politics, are the main targets of conspiracy theorists' repudiation (Prasad 2022). A 'straw person' argument is diagnosed here. Exaggerated claims are attributed to scientists—and subsequently rejected—that they have never in fact made (Fuller 2018; Lynch 2020: 55; Prasad 2022: 89). This strategy creates doubt (Biddle et al. 2017; Elliot and Richards 2017: 158) and undermines the trustworthiness of scientific knowledge, which works so well because science in general—as compared to politics and the media, for example—is highly trusted (European Union 2025). In essence, conspiracy theorists typically denounce scientific findings but refrain from directly challenging the science system itself. Instead, they try to imitate research practices to bolster the credibility of their claims, thereby seeking to exploit the prominence of the science system.

Another movement in point is science denialism. Take the example of the protest movement in Germany concerning the governmental measures against the COVID-19 pandemic. The protesters called themselves *Querdenker*, meaning people whose thinking is supposed to cut against the grain. The *Querdenker* assumed that the COVID-19 virus was not dangerous, as 'mainstream science' claimed. They referred to 'alternative experts', whom they believed to be more credible and trustworthy because of their distance from politicians and governmental institutions. *Querdenker* had a significantly higher rate of secondary school qualifications and academic degrees than the average member of the population; they were above average self-employed persons and belonged to middle-age groups.¹ In terms of socio-structural classification, these individuals belonged to the well-off middle class. However, according to their self-perception, they were unheard and marginalized during the pandemic. They were profoundly engaged with esoteric conspiracy theories and occasionally with right-wing ideologies (Frei et al. 2021; Nachtwey et al. 2023; Pickel et al. 2022). Among those who expressed sympathy for these idiosyncratic persons, 60 percent indicated that *Querdenker* lacked confidence in the scientific community and 73 percent believed that *Querdenker* assumed a conspiracy between science and politics (Kooß and Binder 2021: 309–310). Amlinger interprets this anti-science movement as an "epistemic resistance" (2023: 73) against the socially legitimized authorities of reality observation—that is, against science.

The examples of conspiracy theorists and *Querdenker* suggest that it is not enough to demonstrate that the knowledge they exhibit does not meet scientific standards and

¹ This socio-structural characterization is typical of followers from the southwest of Germany, an economically rich region; supporters from poorer regions had a lower level of education and social status (Jabkowski et al. 2023).

to contrast their beliefs with tried and tested scientific knowledge: it is also necessary “to analyze how anti-science, misinformation and conspiracy are discursively framed and interpreted within and by particular groups” (Prasad 2022: 89). These phenomena are related to the societal role of the science system in knowledge societies, which is largely acquired through the conviction that science provides legitimate knowledge for decision-making processes. Social, political, and other concerns motivate certain groups to espouse conspiracy theories and to join anti-science movements. In this way, we can understand why anti-science movements gain adherents. They feel that their legitimate concerns are removed from the political agenda through recourse to scientific knowledge.

However, this is only one side of the coin. It is also imperative to examine the epistemic validity of conspiracy theories and the arguments put forth by the anti-science movements. Their attacks have serious consequences for scientific knowledge, the science system, and liberal democratic knowledge societies. Following on from this, it is important to ask how they affect the societal acceptance of scientific knowledge, because this is related to the question of whether scientific knowledge is regarded as a legitimate basis for decision-making. The acceptance of scientific knowledge as a basis for decision-making constitutes an essential foundation of liberal democratic knowledge societies (Habermas 1998: 228; Habermas 2021). The reliance of those societies on scientific knowledge is almost indispensable as they search for appropriate solutions to problems, especially ones related to political, legal, and regulatory decisions. Refusal to recognize scientific knowledge as a legitimate basis of decision-making dashes the hope placed in deliberative processes of broad societal participation in the democratic process. Deliberative processes thrive on the exchange of arguments and an agreement on solutions supported by evidence (Habermas 1998; Habermas 2021; Wilholt 2017). The contestations, attacks, and processes of delegitimization have repercussions not only for science, but fundamentally for liberal democratic societies, too.

The use of science for political ends: undermining the credibility of science

However, not every use of scientific knowledge for decision-making processes is conducive to democracy. There is a tendency for scientific knowledge and scientific experts to be embedded in state institutions, which may tend to undermine democratic processes.² An example is the use of scientific knowledge in decision-making processes beyond the scope of democratically legitimated bodies. Such expert institutions may be called non-majoritarian institutions (NMIs), examples being courts and central banks. One of the tasks of NMIs is to control and limit the power of the public and their institutions so that they do not violate individual and minority rights or destabilize the democratic process (Elster 1994). In addition, NMIs are called upon

² Many states have established government mission agencies tasked with processing scientific knowledge for direct use in political decision-making processes. They create publicly authorized scientific knowledge to fulfill state purposes and to support the political decision-making process (Bourdieu 1997).

to implement the targets set by the legislative branch (Ackerman 2000), such as regulations for sustainable agriculture or climate-friendly mobility. International institutions can also be seen as NMIs because they can protect democracy and human rights and help to strive for agreed-upon political goals (Keohane et al. 2009).

We have selected NMIs as a case study to illustrate how scientific knowledge has frequently been incorporated into decision-making processes that significantly impact people's living conditions and opportunities for action, sometimes without sufficient democratic legitimacy. NMIs are often nominated by majoritarian political bodies to exercise political authority. Although these nominations can be politically contested along party lines—United States Supreme Court nominations are the best-known example—the members of an NMI wield epistemic authority after their appointment. NMIs, or ‘counter-majoritarian institutions’ (Rosanvallon 2008), can be defined as governance entities that (a) possess and exercise specialized public authority separate from that of other institutions; (b) are neither directly elected by the people nor managed by elected officials; and instead (c) appeal to scientific knowledge in order to justify their decisions (see also Thatcher and Stone Sweet 2002: 2). They make or prepare decisions of political relevance on their own by drawing on scientific knowledge.

NMIs’ use of scientific knowledge in the political process can be characterized as the ‘epistemization of the political’ (Bogner 2021). In a similar vein, as discussed in section 3, the choice and pursuit of certain policies are based on expert advice. By this, we mean that political controversies are reframed as scientific issues, which indicates that they can be answered by applying scientific procedures, although normative commitments are woven into them. The result is that conflicts about different interests and values are transformed into controversies about the validity and relevance of studies and data, the credibility of scenarios and models, and other scientific information and instruments. In short, epistemic questions take center stage and debates on conflicting values and interests fade into the background.

Epistemization of the political is the common framework for publicly defending policy decisions. This approach features a close coupling of science and politics in liberal democracies, which often compromises the credibility of scientific knowledge. This approach has repercussions for the social perception and recognition of the science system. Societal, political, and economic conflicts are imported into the science, where they are declared to be scientific disputes and controversies (e.g., conventional versus organic agriculture, the safety of vaccinations, renunciation of meat consumption) (Sarewitz 2004; De Melo-Martín and Intemann 2018: 130–142; Barlösius and Ruffing 2023). Importing such conflicts into science systems undermines the societal status of such systems in liberal democratic knowledge societies (Barlösius 2024). This epistemization of the political reveals the profound societal impact of science, and the attacks on science suggest how this societal status of science is increasingly called into question in knowledge societies.

For the studies of science, the question arises as to whether such mutual entanglement can be understood as interdisciplinary cooperation emerging from a coherent center and as producing a generic field. This has been successfully achieved for Science and Technology Studies (STS) (Dear and Jasanoff 2010: 770), but for analyzing the complexity of science in society and society in science in liberal democratic

knowledge societies, cooperation with the “home disciplines”—i.e., reflecting disciplinary accounts—is also demanded (Daston 2009: 808). Firstly, the whole range of the humanities and social sciences is appealed to, especially philosophy and history of science (HPS). These independent disciplinary approaches to the entanglement of science and society are necessary in order to understand the complexity and contested nature of the relationship between science and society. Secondly, the justification, reliability, and relevance of scientific knowledge for the policy issues at hand need to be analyzed by *Wissenschaftsreflexion*. This analysis assumes a normative epistemic standpoint by addressing the suitability and the limitations of scientific knowledge for the policy deliberations at stake. Thirdly, this assumption gives rise to the question of which institutional conditions must be in place for science so that it can continue to produce and communicate such knowledge in the future. All of this means updating Merton’s approach and developing social prerequisites for a productive relationship between science and society to emerge.

An integrative approach in close coordination with home disciplines³

We propose *Wissenschaftsreflexion*⁴ as a specific approach to more effectively address the current challenges posed by the two sides of developed knowledge societies: the societal power of science and the fundamental questioning of the societal relevance of science. Speaking more generally, *Wissenschaftsreflexion* seeks to adopt a reflective stance toward scientific knowledge and its societal and political utilization, as such a stance fosters informed and judicious actions. The German term *Wissenschaftsreflexion* is intended to direct research to the study of and reflection on science itself. What is the spectrum of scientific methods and theoretical concepts and in what sense do they furnish valid and trustworthy knowledge? It is also worth reflecting about the closure that scientific practices produce and on how other kinds of knowledge are delegitimized by scientific knowledge. Which practical questions and problems should scientific knowledge be used to solve? To what extent is it legitimate to favor the practical use of the scientific mode of reflection?

We find that the value of the broad German term lies in its capacity to generate options for addressing science and its societal embeddedness. The integration of multiple levels of reflection, which is characteristic of the term, cannot be expressed in a single English word. Consequently, we will employ the term judiciously in the following, opting for alternative linguistic formulations where appropriate. In the following, we explain the research approach of *Wissenschaftsreflexion*. It is characterized by two main imperatives: (a) an integrative approach that works in conjunction with the various home disciplines of the humanities and the social sciences; and

³ *Wissenschaftsreflexion* has become established in various places in Germany in recent years: Forum Wissenschaftsreflexion of Leibniz Universität Hannover, the working group Interdisziplinäre Wissenschaftsreflexion of the Leopoldina Center for Science Studies, and Kompetenzzentrum für interdisziplinäre Wissenschaftsreflexion of Friedrich-Alexander-Universität Erlangen-Nürnberg.

⁴ For discussion of the fundamental ideas, methods, and topics of *Wissenschaftsreflexion*, see Barlösius et al. (2025), Barlösius and Willholt (2021), Jungert et al. (2020), Jungert and Geis (2024), and Willholt (2017).

(b) an explicitly normative stance, which is mainly implemented by the possibilities and conditions for epistemic judgments, and liberal democracies' need for confirmed scientific knowledge.

We are convinced that research on science in developed knowledge societies should adopt an integrative research perspective, open to all research areas that can contribute their theoretical concepts, methodological reflections, and specific knowledge to work on the issues at hand. The humanities and social sciences play a seminal role in this integrative perspective. The life sciences, natural sciences, and engineering are also part of it and contribute to integrative research projects. To characterize the research approach, we have chosen the term “integrative” rather than “interdisciplinary”. An interdisciplinary approach is governed by the objective of amalgamating disciplinary knowledge, theories, and methods, while an integrative perspective seeks to adjust and change the disciplinary principles. An integrative approach challenges the disciplinary accounts and stimulates their conceptual interplay, thereby producing coherence among factors that might otherwise be seen as contrasting. Such an approach involves the reciprocal interaction and adjustment of knowledge elements in contrast to merely combining knowledge from different fields. In this vein, an interactive approach produces genuinely new knowledge and aims to create an environment where diverse research principles inspire each other.

For instance, bringing together sociological, philosophical, and economic accounts can be an integrative endeavor. Such conceptual interaction can lead to calling into question what appears to be self-evident, to incorporating strangeness into research approaches, or to entwining these perspectives (see sect. 6). In this manner, sociological science studies can also benefit from the debate within political science. For example, the processes of epistemization of the political as described above have a political prehistory that is often insufficiently considered in sociological research. For policy studies, it is imperative to inquire into the specific political domain to which a political problem is attributed. This attribution is the result of political debates about which department should be responsible. The departmental responsibility, in turn, determines which scientific knowledge will be primarily employed to solve the problem. In many cases, the same problem can be attributed to different departments, depending on political convictions. For example, glyphosate is politically viewed as a medical, nutritional, or environmental problem. The expertise used for policy advice varies depending on how the problem is politically framed: either physicians, nutritionists, or ecologists are consulted (Barlösius and Ruffing 2023). In essence, political framing often precedes the decision which scientific knowledge will be used to come to a science-based policy choice (Barlösius and Ruffing 2023). The same applies to cooperation with other home disciplines of the humanities and social sciences.

Integrative research may break up conceptual and theoretical assumptions that are taken for granted, and compare them with the variety of methodological practices and presuppositions encountered in the relevant fields. The great benefit of being open to a variety of disciplines is that it expands and strengthens the self-reflective capabilities of one's own modes of observation, framing practices, and ways of tackling research questions. We do not see home disciplines as being coherent and unified entities; rather, it is important for researchers in those areas to draw on a

comprehensive repertoire of theoretical concepts, methodological skills, and access to a diversity of fields. The aim of bringing together the different competencies is not to overcome disciplinary differences; on the contrary, they should persist so that their interaction may benefit the research.

A second key point of our research approach is that it is conducted in close coordination with home disciplines so as to build on broad theoretical and methodological expertise. The following disciplines are particularly important: sociology, economics, law, political science, philosophy, and historiography, but also the humanities and social sciences as a whole. Cooperation with home disciplines is essential for research on science in society because they have special knowledge, concepts, and methods that facilitate analysis of the academic world's impact on different social systems. This sort of cooperation makes it possible to address research questions related to home disciplines, such as whether historical scholarship should inquire into the beginnings of the knowledge society more than it has done so far. Conversely, the home disciplines benefit from close cooperation with this type of research. Historical analysis, for example, has so far largely neglected the status of science and technology in modern society.

Our research approach could change this attitude and direct the attention of mainstream historiography to the impact of the sciences on the course of society-building. In addition, in accordance with the meaning of *Wissenschaftsreflexion* as a way of reflecting on the sciences, historical studies might benefit from recognizing that norms and values that have prevailed in the sciences intertwine with those in the humanities. A history of knowledge that pays close attention to these guardrails might thus enrich historiography, informing it without threatening to overthrow its ruling paradigm of cultural approaches.

Jurisprudence is another example of how our proposed research approach on the conditions and presuppositions of a discipline can increase its possibilities for self-reflection. One of the problems of jurisprudence from the very outset has been to clarify the meaning of legal norms and to interpret them. For this purpose, the field has created several methods of elucidation oriented toward moral and epistemic values. As empirical research has strengthened, jurisprudence has been called upon to intensify its focus on matters of fact in order to incorporate them into its interpretation of legal norms without abandoning its orientation toward moral and epistemic values.

In summary, our research approach is based on the understanding that, in developed knowledge societies, science and society are interwoven in a complex and conflict-ridden way. In order to analyze this relationship, the full range of the home disciplines is required. The research approach of *Wissenschaftsreflexion* does not aspire to establish an independent domain of inquiry; rather, it is conceived as an invitation extended to home disciplines and specializations in studies on science to engage in research that explores both sides of knowledge societies: the profound impact of science on societal structures and the major contestation of science.

Conditions affecting the justification of knowledge claims

Our approach involves the investigation of the epistemic conditions and the institutional and organizational presuppositions that enable science to arrive at justified claims that are relevant to political and societal challenges. The present section is devoted to outlining the basis of, and the challenges to, the ability of science to produce reliable contributions to socially relevant issues.

Wissenschaftsreflexion integrates epistemic and social elements, including their historical evolution. Accordingly, one of the core elements of *Wissenschaftsreflexion* is that it combines Social Studies of Science and Technology (STS), Social Studies of Knowledge or Science (SSK), and Social Studies of Science (SSS) with history and philosophy of science (HPS). Philosophy of science seeks to outline rational processes of gaining knowledge; it tries to reconstruct and elaborate suitable procedures to arrive at reliable and trustworthy conclusions. Experimentation under controlled conditions, crosschecks, or closing loopholes are likely to elicit dependable outcomes.

More specifically, in the philosophy of science, the basis of normative claims is intuition about general characteristics of outstanding epistemic achievements and about particular achievements or exemplars. General factors include unplanned expansion of the domain of application of a theory. For instance, as William Whewell (1858, bk. II, chap. V) influentially pointed out, the successful prediction of novel facts, as accomplished by a theory, boosts the justification of the theory. This does not mean the simple extension of what was known before, such as continuing a curve line, but the truthful anticipation of effects different in kind from those observed. For example, general relativity theory successfully predicted black holes, gravitational time dilation, gravitational waves, and gravitational lensing, all of which were completely new and could not have been expected on the basis of observation alone. The second facet of successful anticipation, also elaborated by Whewell, is the unplanned unification of what appear to be phenomena different in kind. For example, classical mechanics gave a unified account of the motions of the planets and the tides, while electromagnetic theory unified the motion of charged particles in electric and magnetic fields with various kinds of electromagnetic radiation (light, infrared, ultraviolet, and so on). Such outstanding epistemic achievements suggest that the theories involved are reliable or truthful.

However, the production of knowledge is not a matter for rational individuals alone. Rather, social epistemology has revealed and elaborated that the social exchange of arguments and criticism within the scientific community are pivotal elements of testing scientific knowledge claims (Longino 1990: 63–82; Fuller 2002). As seen in Merton (1942), social rules within the scientific community have epistemic bearing. Reciprocal checks and mutual control among scientists are far more effective at weeding out viable claims than testing one's assumptions in isolation. In social epistemology, objectivity is no longer considered the view from nowhere, but rather the view from a plurality of angles. Francis Bacon ([1620] 2017) posited that scientists should approach nature without preconceptions. This recipe has turned out to be unrealizable, and the version improved by social epistemology is to approach nature from a variety of competing perspectives. This places criticism within the scientific

community at center stage. We improve the state of knowledge by following certain social rules.

However, empirically confirmed hypotheses are not tantamount to recognized knowledge. Justified trustworthiness is not the same as socially accepted beliefs. As a result, the interaction between claims made in science and processes of knowledge formation in society needs to be taken into account. Particular choices of what to select for research are thoroughly affected by social considerations. More often than not, the prospect of application determines which issues are tackled. As a result, such social choices shape the body of knowledge produced by the research. Questions that are not asked are not answered.

Social values enter the research process in additional ways, too. Since value-free research on social and political objects has proven to be unfeasible (Douglas 2009), the influence of values on research needs to be controlled. One relevant demand is that all viable social values be represented in the research process (Lacey 2013). A more recent conundrum is the “new demarcation problem” (Holman and Wilholt 2022), stating the challenge of distinguishing between beneficial and detrimental roles of social and political values in the research process. This inquiry raises the question of which normative resources science should draw on in a society holding multiple, and often contradictory, values. One indisputable exigency is a relatively high degree of academic freedom, which should be accompanied by a relatively high degree of institutional autonomy. Such autonomy concerns the right of the scientific community to decide for itself the justification of validity claims. This autonomy also lays the ground for the societal credibility of science.

Another integral part of our approach is to address reasonable concerns about scientific misconduct and replicability failures. There has been a good deal of research on justified and unjustified questioning of validity in recent decades (Carrier 2017; McIntyre 2019; Zachmann et al. 2023). Science is not faultless, and one of the steps needed to regain public trust in it is to improve parts of scientific practice. A disquieting share of studies, particularly in social psychology and biomedicine, has proven to be unreliable and not replicable (Hendriks et al. 2020; Wingen et al. 2020). The two factors usually blamed for this failure are the commercialization of research and the academic incentive system. A slightly different variety of misleading claims associated with science is agnotology, the deliberate production of ignorance. Powerful figures in politics and the economy have repeatedly called established scientific knowledge into question by using fallacious arguments in order to pursue political goals. Relevant cases have concerned health risks and climate change, and the intentional dissemination of fake information has proved effective at blocking political action to regulate the relevant matters (Carrier 2023). However, this knowledge about contestations and delegitimizations remains unsystematized and unsynthesized. It is an important challenge to develop ways to identify such agnotological ploys and to cope with them.

However, in order to analyze the different kinds of epistemic concern, it is not enough to consider only the processes of knowledge production, because they provide only limited insights into the societal causes of such concern. Additional research perspectives are necessary for such analyses. Scientific knowledge and the science system are no longer the natural starting and end points of analyses about

how science is handled epistemically, societally, politically, economically, culturally, and legally. For this reason, *Wissenschaftsreflexion* also focuses on examining the repercussions that science in society and society in science have on the way scholarly knowledge is produced. To accomplish this end, our approach collaborates closely with the home disciplines.

One well-founded reason for rejecting scientific expertise invoked in political and governmental processes is that this kind of reference is often based on unspecified, sometimes even ill-conceived, normative assumptions. This lapse raises the question of how epistemic responsibility (Rolin 2017) should be conceptualized. Should it encompass epistemic as well as moral aspects? We have pointed out that many institutions with decision-making authority (e.g., NMIs) base their judgment on scientific expertise. Their decisions often have a profound impact on people's lives without first acquiring sufficient democratic legitimacy.

The upshot is that reliable scientific knowledge is needed for deliberative democratic decision-making and that such knowledge can be produced by invoking a bundle of scientific methods. Yet science sometimes fails to comply with such demanding standards. In particular, the commercialization and politicization of science may provide a one-sided picture, while social conditions such as the incentive system may favor superficial work. Appreciating science means upholding or establishing standards of stringent testing and critical inquiry that are liable to produce robustly confirmed and trustworthy claims. Even granted that a plethora of legitimate social influences is exerted on the body of scientific knowledge, the key distinction to be respected is between justified and fruitful ways to contest scientific knowledge and expertise and ways that are unfounded. Groundless allegations on the part of science deniers and sweeping, unsubstantiated doubt jeopardize the ability of the science system to perform its proper tasks and societal functions.

Liberal democracies' need for informed knowledge

Well-confirmed and relevant knowledge is indispensable for deliberative decision-making in liberal democratic societies. Conversely, societal conditions contribute to fostering the production of such knowledge. Among the pertinent conditions is freedom of research, since such freedom makes science independent of social forces and thus provides a standard for judging political claims regarding matters of fact (Gläser et al. 2022). The mutual benefits of liberal democracy and autonomous science, wherein scientific freedom is guaranteed, have been frequently argued, especially by Merton as mentioned above.⁵ In particular, Merton argues that in liberal democracies the ethos of science that vouches for the epistemic integrity of research is consonant with the value commitments underlying the social order (Merton 1942: 270–275). However, science should remain at arm's length from politics and exercise scientific restraint. The political impact of scientific knowledge should be limited to the factual aspects of a political issue and leave value-related aspects as far as

⁵ Merton's famous article "The Normative Structure of Science" (1973) originally appeared as "Science and Technology in a Democratic Order" (1942).

possible to the political debate. This militates against the epistemization of political strife (see section 3). For instance, in the COVID-19 debate, the implicit assumption in some cases was that medical knowledge allowed politicians to pick a policy. However, a variety of social values may be invoked. The medical approach favors lives saved; the psychological approach emphasizes the well-being of the population; and the economic approach features the strength of the economy. A policy is picked by trading off such values. Scientific knowledge in itself is unable to suggest any specific policy. Being transparent about the different roles of scientific knowledge and social and political values in public debates does a lot to shelter the science system from unjustified attacks.

We are faced with the paradoxical situation that science has become increasingly powerful in shaping the world by the academization, epistemization, and scientification of all aspects of life while at the same time being increasingly attacked by anti-science movements, conspiracy theories, and disinformation. In the first decades of the transformation to knowledge societies, the prevailing sentiment was that science was largely insulated from potential attacks, especially within liberal democracies. Concurrently, these societies often held the conviction that education, particularly higher education, and the expanding scientification of all domains of life would prove mutually beneficial and offer a compelling rationale for its legitimacy. John Dewey ([1937]/2020: 31), for example, believed that the maintenance and further development of democracy depends decisively on whether and how scientific knowledge is taught. Since Dewey's call to teach and practice democratic attitudes in educational institutions, vast educational expansion has taken place at many levels, including higher education. However, does higher education observably guarantee the recognition of scientific knowledge as a suitable basis for appropriate problem-solving? Even more importantly, is it advisable to continue to hope for a link between education and democratic attitudes? The escalating contestation and delegitimization of scientific knowledge and the mounting populist protests skeptical of democracy cast doubt on such a connection.

As mentioned above, recent macrosociological studies have come to a similar conclusion with regard to the expansion of science and the scientification of almost all aspects of life (Lerch et al. 2022; Schofer et al. 2022; Cole et al. 2023; Lerch et al. 2024). The expectation that the increasing scientification of society would lead to broad social agreement that "all accessible knowledge" should be used in political decision-making has not been realized (Voßkuhle 2005: 426). It is becoming increasingly clear that science is regarded differently outside the science system than within. This requires paying more attention to the inherent logics of the other social systems involved (e.g., politics, media, and social stratification) and adjusting the concepts and means to grasp them. To apprehend how science operates in society, one needs to understand the inherent logics of the different social systems. This goal is best achieved in collaboration with the home disciplines.

From the normative point of view, studies on science are called upon to devote more attention to the question of how it can be ensured that science can continue to fulfill the societal task assigned to it by liberal democratic knowledge societies of providing reliable and relevant knowledge for political decisions. The precondition is the protection of science from arbitrary relativization. This includes responsibly

ensuring the possibility of generating knowledge that facilitates informed and prudent decisions. Accordingly, the societal and political use of scientific knowledge should be undertaken conscientiously. It is therefore pivotal to ensure that scientific knowledge is not used for show, such as justifying political decisions that have already been made or government action that has already been determined. Such uses provoke the loss of public credibility of scientific knowledge, even though the culprit for this abuse is politics, not science.

The academic system cannot assume sole responsibility for defending scientific knowledge and the science system against unfounded threats in developed knowledge societies. Societal attacks demonstrate that scientific knowledge and the science system have become part of major social and political conflicts. Given the centrality of science in liberal democratic knowledge societies, attacks should be recognized as a general societal and political challenge and not be treated as merely a concern of scientists and the science system. The task, of course, is to protect scientific knowledge, scholars, and the science system from unfounded assaults, not from justified criticism. We regard this as a prerequisite for science to be able to fulfill the social tasks assigned to it in liberal democratic knowledge societies.

Positioning *Wissenschaftsreflexion*

The preceding statements likely prompt inquiry into the objectives of our initiative to advocate *Wissenschaftsreflexion*. Is it to establish a novel field of research, to found a new discipline, or to create a new branch of studies on science? As previously delineated, we conceptualize *Wissenschaftsreflexion* as a research approach, not as a novel field of research. Consequently, it is not perceived as being in competition with established research domains such as SSK, STS, SSS, and HPS. We use the low-key term “research approach” in view of our commitment to integrating fields rather than creating a field of our own.

In this respect, we do not find it problematic if individual areas of studies on science, such as the history of science, have “become self-consciously disciplined” and have moved toward general history (Daston 2009: 808; Vandermoere and Vanderstraeten 2012). We understand *Wissenschaftsreflexion* as a research approach, whereas STS perceives itself as a “discipline” (Dear and Jasanoff 2010: 768; Jasanoff 2012: 439) or as a separate academic field (Lynch 2016: 110; Anderson 2024: 1215, Sismondo 2009; Felt et al. 2024). In this respect, our objective is not to compete with already established studies on science, which have developed into generic branches of research and disciplines. In alignment with STS, SSK, and SSS, our approach posits that humanities and social sciences particularly are geared toward investigating science in society and society in science. Our research approach also has a “reasonable familiarity” with “sociological, political, historical and legal studies” (Jasanoff et al. 1995: xi). The same goes for HPS, which informs our analysis of standards of justification and their changes in history. *Wissenschaftsreflexion* extends what is called integrated history and philosophy of science into the realm of social, economic, legal, and other factors. It enriches HPS with social elements and STS with epistemic considerations. As with STS, the research approach under consideration is

conceptualized as an "object-centered field of study" (Dear and Jasanoff 2009: 772). However, it is distinguished by its focus on the specific challenges posed to science in developed knowledge societies.

Conclusion: more *Wissenschaftsreflexion*

As a result, a core element of *Wissenschaftsreflexion* is that it combines social studies of science (SSS, SSK, STS) and HPS. It seeks to bring together normative claims about epistemic standards and their implementation in the scientific community with an analysis of the proper role of science in liberal democracies and knowledge societies. *Wissenschaftsreflexion* strongly and intimately intertwines normative judgments about epistemic justification and empirical research on the processes of knowledge production and on science and society.

Such a two-pronged normative and empirical approach is needed, particularly in the present time when science is particularly under pressure. Science is subject to attacks from detractors of liberal democracy who oppose academic freedom and the use of science as a basis of political decision-making. Our thesis is that the increasing attacks on science are no coincidence; nor do they signal the end of the knowledge society. They are the flipside of knowledge societies, where scientific knowledge has a profound impact on decision-making. *Wissenschaftsreflexion* responds to the interdependence between the science system and the knowledge society, critically reflects on it, and takes a stand. In recent decades, STS in particular has been concerned with the interactions between science and society, often focusing on critical examination of the extent to which science and society are intertwined and the power constellations that determine these interactions. This approach has yielded important insights. Accordingly, SSS, SSK, and STS have not become less important. *Wissenschaftsreflexion* is conceptualized as a supplement to these approaches, distinguished by its close collaboration with the home disciplines, its epistemic and integrative approach, and its normative stance on scientific knowledge, academic freedom, and relatively independent research (Lai 2023).

The new role of *Wissenschaftsreflexion* is to make clear that reliable knowledge is indispensable for guiding humanity through the perils posed by developed knowledge societies and threats to liberal democracies. Science and liberal democracy support each other, as Merton (1942) saw, in that both feature open quest for the best answer, benefit from the free exchange of arguments, assess these arguments by impersonal standards, and seek the distinction of scientists by merit alone.

Wissenschaftsreflexion is called upon to elaborate and illuminate the importance of scientific knowledge for political decision-making. The current hostile attitude to which scientific knowledge and many scientists are exposed calls for a stronger focus on the freedom to pursue scientific work and an emphasis on the importance of scientific knowledge for decision-making processes, especially in liberal democracies. On the whole, science needs to be kept in play as a factor in political decision-making, while the legitimate limits of science-based advice in social and political matters need to be respected. Science needs to be restored to its rightful place, which means

that fake facts and expertocracy should both be avoided. This constitutes the normative stance of *Wissenschaftsreflexion*.

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