Knowledge and Values. A re-entanglement in epistemic regimes[*]

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Abstract

[67] Knowledge and values are the two main ingredients of public decision making. In the past, the predominant paradigm of such decision making was based on an approach of value-neutral science and aimed at processing both ingredients in a disentangled way. However, this approach has some theoretical and practical drawbacks, for which reason several alternative paradigms of public decision making arose. In this paper we highlight the importance of another paradigm of such decision making within so-called *epistemic regimes*. We do so against the background of the discussion of value-neutral science and provide a conceptual analysis of the notion of a *regime* which allows us to outline the underlying structure of re-entangling knowledge and values in epistemic regimes.

Keywords: decision making, social choice, value-neutral science, science studies, epistemic regimes

1 Introduction

Public decision making is a complex process which involves several ingredients interacting with each other and which is due to its ample effects particularly intended to be robust and as faultless as possible. As orthodox decision theory has it, the ingredients needed for individual decisions are knowledge in a broad sense – including also probabilistic estimations – and individual values in form of preferences or utilities. These two ingredients are not only the main ingredients of a simplified model of decision making, but they are also stressed as *the* relevant factors in application-oriented science and technology studies. So, e.g., Geels (2016, p.166, the emphasis in the following is by us) also mentions them explicitly, when he characterises his study of research, namely so-called *system innovations*, as "involv[ing] changes in the supply side (e.g.

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technology, *knowledge*, industry structures) and the demand side (*user preferences*, cultural meaning, infrastructure)". In individual decision making these ingredients are *rationally* combined, if the decision maximises the expected *individual* utilities and preferences (cf. Steele and Stefánsson 2015). In *public* decision making a rational combination consists in maximising the expected *collective* utilities and preferences, which involves as further ingredient a process of aggregating individual preferences and utilities to a collective one. Problems of such aggregations, impossibilities, and different strategies to overcome them are investigated in social choice theory (cf. Gaertner 2009).

Traditionally, information gathering and knowledge production is considered to be a task of science. For a long time this process also included parts of the other decision theoretical component, namely value statements. So, the process of knowledge production was already influenced by values. This was the case, e.g., when scientists were restricted in investigating alternative hypotheses and theories due to the alternatives' predicted unfavoured social impact (think, e.g., on restrictions in early medical research due to a religiously-laden idea of man, or think, e.g., on the exclusion of Copernicus' theory for a long time due to its feared revolutionary social consequences). However, at the beginning of the twentieth century a new paradigm regarding knowledge production arose, namely that of *value-neutral science*, which aimed at reducing and finally eliminating the impact of values in knowledge production. This paradigm led to a task-splitting model for public decision making: According to this model, regarding the two main ingredients *knowledge* and *values*, the former and only the former is thought to be provided by science alone, whereas the latter is accounted for by the public in general and politics in particular. According to this paradigm of public decision making, knowledge and values are *disentangled* in their phase of production and combined only when utilised for making a decision. What we call here a model of 'task-splitting', is in science and technology studies also sometimes called a model of 'division of moral labor': "Divisions of moral labor [that] are evident in the culturally-accepted responsibility of scientists to work for progress by conducting good basic research, while others (regulators, citizens, professional ethicists, etc.) are responsible for controlling the societal impacts of the application of this science" (Fisher and Rip 2013, p.178).

An important advantage of this standard approach to public decision making is a clear separation of responsibilities. However, there are also several problems of this model. First, there is the problem that already due to theoretical reasons values cannot be completely eliminated from the process of knowledge production. [68] And second, there is the problem that due to practical reasons actual public decision making can often not be considered just as a simple combination of two separately gathered ingredients: What we know often depends on what we prefer and utilise; and what we prefer and utilise often depends on what we already know. For this reason, alternative models of knowledge production and public decision making arose and become more and more influential, as is studied, e.g., by Gibbons et al. (1994), Barben (2007), and Campbell and Pedersen (2014). Such a re-entangling of knowledge and

values can come in many ways. One form consists in taking in values into the scientific process of knowledge production again (cf., e.g., Douglas 2000). Another form consists in distributing knowledge production also to fields other than academia. So, e.g., performing research in private industry which clearly also has marketing interests is a way of re-entangling knowledge and values. Finally – and this concerns the form we are most interested here – arising institutions of public decision making that provide values via being legitimated policy makers, but which also produce knowledge themselves lead to another form of re-entangling knowledge and values. These institutions are not private, since they are entrenched into public institutions of modern democracies. And they are also not academic in the traditional sense of scientific institutions. Rather, they can be best described as so-called *epistemic regimes* which consist in a combination of normative control elements that are typical for science, the public, but also the private sector (for the regime notion in general cf. Krasner 1982). An advantage of considering knowledge production of these institutions by help of the *regime* notion is that this notion allows for having a look at scientific and extra-scientific forms of knowledge gathering and production, whereas traditional notions established in science studies like that of a *paradigm* or a *research programme* focus on traditional scientific forms of knowledge production only.

In this paper we investigate this re-entangling of knowledge and values in public decision making via epistemic regimes. Our investigation consists of the following steps: In section 2, we outline the basic principles of orthodox decision theory and show how in the debate of value-neutrality of science subtasks of decision making were demarcated into the task of providing probabilistic information (knowledge) and the task of providing preferences and utilities (values). In section 3, we discuss some main problems of this approach and indicate that so-called "regime configurations" provide a new form of public decision making. In section 4, we provide an explication of the notion of a *regime* and its subspecies, that of an *epistemic regime*. In section 5, we compare the notion of an *epistemic regime* with other notions that are well entrenched in science studies and mark some important differences. In section 6, we outline how epistemic regimes as new institutions of public decision making re-entangle the decision theoretical subtasks of providing knowledge and values. We briefly conclude in section 7.

2 Science and Public Decision Making

Usually the picture of how public decisions ought to be made is assumed to be relatively clear: One just takes decision procedures for the individual case and lifts them to the social case by help of aggregation methods. According to common theories of (individual) rationality, decision situations contain two relevant ingredients: on the one side there are the individual interests expressed in form of utilities of an action or outcome; and on the other side there is knowledge about the probability of such an outcome or at least some information

about possible alternative outcomes and consequences.

In the most specific case, the utilities as well as the relevant knowledge is available in a metric form: utilities in form of degrees of use, and knowledge in form of degrees of belief or probabilities. In such a case, according to common decision theory tracing back to *John von Neumann and Oskar Morgenstern*, one just has to consider all relevant outcomes and consequences of an action, assign degrees of use and degrees of belief, and then choose among the relevant alternative actions that one, which *maximises the expected utility*, i.e. the one, whose outcome's and consequences' product of the degree of use and the degree of belief is maximal compared to that of the alternatives (cf. Steele and Stefánsson 2015).

In a less specific case, the utilities might be available in metric form, but knowledge is only available in qualitative form: Specific outcomes and consequences are considered as possible or impossible, plausible or implausible, probable or improbable. In such a case one cannot, of course, apply the method of maximising expected utilities. But one can perform other decision theoretic procedures as, e.g., the *Maximin* or the *Maximax* decision rule. The former suggests to opt for that action which maximises the minimal possible utility of an outcome compared to its alternatives. Whereas the latter suggests to opt for that action which maximises the maximial possible utility of an outcome compared to its alternatives (cf. Hempel 1965, chpt.3).

To apply these theories within the realm of public decision making one can try to aggregate the individual preferences and utilities and perhaps also different individual opinions about what ought to be considered a possible consequence of an action and what not. Afterwards, one can try to apply one of the above mentioned decision methods to the aggregated information and by this end up with a rational public decision. Of course, there are several alternatives and modifications of the procedure drawn here discussed in the literature, and it is also clear that each step in the procedure is prone to theoretical as well as practical problems that are very hard to overcome (cf. Gaertner 2009). However, the idea of public decision making resembles that of individual decision making inasmuch as it is connected to maximising-strategies and that for this purpose two ingredients are necessary, values in form of utilities, and knowledge in form of probabilistic information or listing possible consequences.

The exact role of science and politics in such a decision theoretic framework was intensely discussed in past and is still highly controversially discussed today. Historically seen, the debate was about the question whether it should be part of scientific methodology to be *value-neutral* or *value-laden*. This debate about value-neutrality of science was initiated by the sociologist Max Weber at the beginning of the twentieth century: Weber and his colleagues conduced a campaign against well-established sociologists like Gustav Schmoller by bringing this topic on the agenda of several research colloquia. In his reaction to this campaign Schmoller argued for an obligation of making value judgements in sociology based on his view on university education which should transmit political, ethical, artistic, and cultural values to young people (cf. Koslowski 1997, p.5).

Against this stance, Weber argued that value judgements cannot be scientifically justified and that a scientist making such judgements transgresses her area of expertise (cf., e.g., Weber 1913/2012, pp.304f). According to Weber, she is therefore *qua* scientist not legitimated to make value judgments and in case she still makes such judgements, [69] she is supposed to make explicit that these are not within her area of expertise (cf. Weber 1913/2012, p.307).

Weber's point of view quickly became the predominant position within sociology and science in general. Philosophers of science have explicated the postulate in more detail by differentiating contexts of scientific practice, normative statements, and values. Regarding the first, in accordance with Hans Reichenbach's proposal, it is common practice in the philosophy of science to distinguish between the *context of discovery*, the *context of justification*, and the *context of utilisation*. The context of discovery concerns all matters of theory and hypothesis invention and is clearly excluded from the value-neutrality postulate since it is generally admitted that scientists are driven in this stage by personal interests. Alike it is generally assumed that also what is done with scientific knowledge is and should be clearly value-dependent. However, it is the context of justifying theories for which Weber and the bulk of the scientific community accepts the value-neutrality postulate. Since even in the context of justification epistemic values such as truth-aptness play an important role, the postulate is also restricted to non-epistemic or extra-scientific values. And since even non-epistemic value statements might be acceptable, one has to differentiate between hypothetical and categorical statements, where the former express a means-end-relation: If e is a goal or end, then means m is optimal to achieve e; and the latter expresses an unconditioned value statement of the form: You ought to aim at goal or end e! Since hypothetical value judgements are just optimality claims that can be justified scientifically, they are also excluded from the value-neutrality postulate. To sum up, the explicit form of the postulate is as follows:

> **The value-neutrality postulate**: The context of justification of scientific theories ought to be neutral regarding non-epistemic categorical value statements.

It is not hard to figure out the exact role of science in public decision making: Such decision making presupposes value statements as well as knowledge; since science can provide only the latter and is, according to the postulate, prohibited from providing the former, the task of science in public decision making is to provide probabilistic information and matters of fact. The values needed for such decision making stem not from science, but from the public in general, and from politics in particular.

3 Problems of Value-Neutral Science

The approach presented in the preceding section tries to draw a clear picture of public decision making by separating the tasks into a purely descriptive part

stemming from science and a normative part stemming from the public and politics. However, in the literature one finds several problems of such an idealised position. One side of the demarcation is implicitly criticised, e.g., by so-called "citizen science", where scientific expertise is backed up on investigations performed by layman (cf. Hand 2010). This quite new trend of citizen science locates tasks that were traditionally considered to be typically scientific within the public realm. The other side of the demarcation, i.e. the claim that scientists ought to be value-neutral, is criticised, e.g., by the following arguments:

- Feedback-loops: Normative statements within the contexts of discovery and utilisation retroact on the context of justification (for the discussion of different forms of feedback loops and their relevance regarding responsibility of science, cf. Christian and Feldbacher-Escamilla submitted).
- The value-ladeness postulate: Even if scientists' role is considered only within the context of justification, they need to make value judgements in order to assess and justify hypotheses and theories.
- Shift of epistemic/knowledge regimes: De facto public decision making transforms from applications of a separated model to an integrated model of knowledge and values.

The first problem is easily put, but also easily addressed: If one takes hypothesis and theory assessment to be a comparative task within the context of justification, and if some normative statements – may they be part of the context of discovery or that of utilisation – prevent the formation of a diverse and broad set of hypotheses and theories, then of course these normative statements also influence the context of justification. Such normative statements could be ideological codes (as an example think of the Lysenko case in the Soviet Union, cf. Soyfer 2001) and codes of ethics (for an example see Christian 2017). However, from a value-neutral standpoint of science one can easily overcome the problem by conditionalising scientists' assessment statements on the general conditions put forward by such normative statements. According to this solution, scientists' assessment statements have to be read always with a preamble of the form 'Given the normative restrictions of the discovery and utilisation context it holds: ...'. One just has to recognise that assessment statements with such a preamble are only hypothetical value statements and by this also by value-neutralists accepted within the realm of science. Again, we think that this is not only a theoretical position within philosophy of science, but also put forward in science and technology studies, e.g., by Böschen (2019, p.43) who argues that it is crucial for successful technology assessment to "rethink epistemic authority and quality to uncover its own (otherwise implicit) politics" – such an uncovering or explicit-making is, in our terminology, exactly what is going on in conditionalisation.

Much trickier and controversial is the second problem. This debate started with Richard Rudner's "The Scientist Qua Scientist Makes Value Judgments"

in 1953 and led to the so-called *argument of inductive risk* (cf. Hempel 1965, chpt.3): The justification of scientific theories is almost never a matter of strict falsification or verification, but mainly an uncertain matter of estimating probabilities and accepting or refuting hypotheses according to these estimations. Taking this into account, there is almost always a risk of accepting a probable, but still false hypothesis or theory, and also the risk of refuting an improbable, but true hypothesis or theory. How to deal with this risk can almost never be decided on epistemic reasons alone, since consequences of accepting or refuting hypotheses and theories usually effect a more or less wide public. Contrariwise, it is non-epistemic values that are needed in order to decide on which risk to accept and which not. Hence, so the conclusion of this critique, science presupposes non-epistemic value judgements (cf. Rudner 1953; Longino 2008, et al.). This consequence was not only cherished in the more traditional discussions of philosophy of science, but also in science and technology studies. As Böschen (2019, p.42) puts it: "*value-ladenness* of technology assessment was basically acknowledged in past".

Again, in principle one can apply the same strategy as above and overcome the problem by conditionalising on even bolder general conditions of the form 'If inductive risk to a specific degree is accepted, then it holds: ...'. One can also restrict scientists' tasks to providing probabilistic assessment statements only, but not to accept or refute hypothesis or theories (cf. Jeffrey 1983). [70] However, since the assumptions of such a solution get stronger and stronger, it is also discussed very controversially.

More important for our discussion is, however, the third problem, the shift of epistemic/knowledge regimes. Especially in the field of international relations it is assumed that the borderline between institutions providing value statements and institutions providing knowledge vanishes; and even for a good reason. Barben (2007) describes the former model of public decision making as follows:

> "Science and engineering became integrated into the procedures for regulating technological risks by providing measures and means for assessing them. [...] According to the idea of a clear boundary, it was considered the obligation of scientists and engineers to pursue true knowledge and efficient technologies, while the application of science and technology was seen as the responsibility of government and industry." (cf. Barben 2007, p.58)

However, as Barben (2007) observes, this so-called "regime configuration" was challenged especially in the aftermath of World War II. As an example, he mentions the discussion about the role of physicists and engineers who have developed the atomic bomb, but also the role of physicians in medical experiments executed in Nazi Germany. The latter debate led to a new widely accepted formulation of medical ethics in the so-called *Nuremberg Code* of 1947 which can be considered to be a precursor of the current ethical standard regarding human experimentation, the *Declaration of Helsinki*. More generally, "the engagement of scientists and engineers in bellicose projects of spectacular destruction

[...] generated claims for new forms of (self-)regulation and accountability" (cf. Barben 2007, p.59).

This is not only a phenomenon of the past, but a still ongoing and even intensifying phenomenon raised by new technical opportunities: "As a result of the often broad resonance of biotechnology [etc.] issues in society, claims for new forms of social accountability and consultation in science and technology affairs were raised again and again." This integration of research with ethical, legal, and social issues (*ELSI*) is directed against the ideal of separated tasks for science and politics (cf. Barben 2007, pp.65f). Also Böschen (2009, pp.517f) diagnoses a violation of the "orthodox view of science in political decision making", the view that science is a "disinterested provider of objective knowledge". He claims that an "inadmissible mixing-up of knowledge and power is observable" (Böschen 2009, p.508). We will show below that such an integration and shift of knowledge production and authorisation towards the political sector can be described by help of the notion of *epistemic regimes*. We do so by first characterising the underlying notion of an *epistemic regime* in detail.

4 Regime Analysis

In this section we introduce the concept of a regime, specify it to that of an epistemic regime, and discuss briefly some applications in politics, sociology, and science studies.

In the context of knowledge production and knowledge gathering, the notion of a "regime" is widely used in sociology (in particular, e.g., in social studies of science, cf. Maasen et al. 2012) and political science (cf. Krasner 1982), but recently also an increasing interest arose within philosophy (Kaiser et al. 2010). The core domain of regime analysis is international politics, and one of its main representatives, Stephen D. Krasner, characterises the notion of a "regime" as follows:

> "Regimes can be defined as sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations. Principles are beliefs of fact, causation, and rectitude. Norms are standards of behavior defined in terms of rights and obligations. Rules are specific prescriptions or proscriptions for action. Decision-making procedures are prevailing practices for making and implementing collective choice." (Krasner 1982, p.186)

It is quite common that regime analysts include their specific domain of application already in the definitional criteria of 'regimes' (cf. 'international relations' in the characterisation above, but also, e.g., the reference to the domain of risk assessment in (Hood, Rothstein, and Baldwin 2001)). If one abstracts from the specific domain of international relations and also from the formal differences between principles, norms, rules, and instructions of procedures,

then a regime is considered to be a set of normative statements about a specific *issue-area* (cf. Krasner 1982, p.188, p.191) on which agents concerned with the issues of the area agree. According to this characterisation, three components are relevant for regimes, namely the normative statements of a regime, its agents, and its issue-area. The normative statements might be differentiated regarding content, and not form, into *control components* for *information gathering*, for *setting standards*, and for *modifying behaviour* (cf. Hood, Rothstein, and Baldwin 2001, p.22; and Janning 2008, p.114). Since many normative systems like temporary arrangements share such a structure, regime analysts usually put forward some further constraints, whereof some degree of continuity over time or stability is one of the most widely shared constraint (cf. Hood, Rothstein, and Baldwin 2001, p.9; Krasner 1982, pp.186f; Geels 2016, p.170; and Fisher and Rip 2013, pp.178f): Whereas agreements are considered to be ad hoc arrangements for specific purposes, the purpose of regimes is seen in their ability to facilitate agreements in a continuous and stable way (here the literature on regimes is ambiguous: Whereas (Krasner 1982) excludes ad hoc arrangements for specific purposes from the concept of a regime, (Janning 2008, p.132) considers such arrangements as a special form of a regime, namely a cooperation regime).

With 'continuity' it is meant that the normative statements remain unchanged or that they are only slightly changed, whereas it might be easily possible that the exact procedures for achieving the aims vary (Krasner 1982, p.188; Barben 2007, p.56). And 'stability' means that the set of norms constitutes a holistic and interdependent complex, where it is "difficult to change one rule without altering others" (cf. Geels 2016, p.170). To sum up, we characterise 'regimes' in the tradition of regime analysis as follows:

> **Regime**: A regime is a set of normative statements about gathering information, setting standards, and modifying behaviour regarding a specific issue-area on which some agents concerned with the issues of the area, and granted authority in this respect, stably agree on.

A word of caution with respect to this characterisation is in place here: According to this characterisation of the notion of a *regime*, regimes are sets of norms. However, in the literature and also in the following parts of this paper, 'regime' is quite often used also for the institutional body ascribing to such a set of norms or putting forward such a set of norms. In this sense, the notion in use is systematic ambiguous. However, this notion in use can be easily disambiguated: A regime in the sense of an institutional body is any institutional body that stably and granted with authority agrees on a [71] regime in the sense of a set of norms. Both notions are interdependent: Whenever one speaks of a 'regime' in the sense of an institutional body, then also a regime in the sense of a set of norms is related to it (as is outlined in the characterisation above); and whenever one speaks of a 'regime' in the sense of a set of norms, one also has in mind agents which agree on this norms in a particular way and which can be considered to be regimes in the sense of institutional bodies. We think that in the following the context makes clear which exact notion is in place.

A paradigmatic example of a regime is the so-called regime of the *World Trade Organisation*, for short 'WTO-regime', which consists of norms for gathering information as, e.g., the norms underlying the annual international trade statistics, norms for setting trade standards, and also norms for punishing breaking of such standards; it is clear that the issue-area of the regime is within the realm of trade (with all its connections to topics like copyright etc.) and that the agents agreeing on these norms are the 164 member states of the WTO. And it is also clear that, although the core of the norms remains stable, some applications to specific situations are highly debated and their interpretation is in flux; for illustration of this consider, e.g., the case of Brazilian government allowing the production of generics for HIV treatment by stressing the WTO-member states' right to undermine patent law in case of unsuccessful negotiations regarding matters of extreme national urgency (article 31,b of the intellectual property treatment TRIPS[1]; for details cf. (Bjornberg 2012); a sketch of a regime analysis of this case is provided in (Barben 2007, p.66).

We want to highlight that due to the normative nature of the statements on which agents concerned with an issue area agree on, these agents are also to be considered as authorities regarding that area. Since they have, so to speak, the relevant power to put forward (and dominantly enforce) the respective norms, they are also assumed to be granted authority to do so. With the exception of (Böschen 2016, 2019), this aspect of the notion of a *regime* is typically not taken into account. However, it seems that without such an authoritative understanding of the involved agents, one would be either prone of characterising an inadequate notion of a *regime*, or one would fall victim of an *is-ought-fallacy*. The former is the case, e.g., when a group of agents or institutions more or less accidentally stably agrees on a set of norms, without any normative force derivable from this. The latter is the case, when one derives, e.g., from the purely empirical fact of stable agreement of a majority or a group, which is capable of dominantly enforcing the norms it agreed on, such a normative force or authority. In order to avoid these two problems, we think it is important to explicitly mention what allows one to derive normative force from the *regime*-notion when characterising the notion, namely the *authority* of the agents involved in the issue area.

[1]The exact normative statement reads as follows (https://www.wto.org/english/docs_e/legal_e/27-trips.pdf, accessed: 2019-09-01):
TRIPS Article 31: Other Use Without Authorisation of the Right Holder
Where the law of a Member allows for other use (7) of the subject matter of a patent without the authorisation of the right holder, including use by the government or third parties authorised by the government, the following provisions shall be respected: [...] (b) such use may only be permitted if, prior to such use, the proposed user has made efforts to obtain authorisation from the right holder on reasonable commercial terms and conditions and that such efforts have not been successful within a reasonable period of time. This requirement may be waived by a Member in the case of a national emergency or other circumstances of extreme urgency or in cases of public non-commercial use. In situations of national emergency or other circumstances of extreme urgency, the right holder shall, nevertheless, be notified as soon as reasonably practicable. In the case of public non-commercial use, where the government or contractor, without making a patent search, knows or has demonstrable grounds to know that a valid patent is or will be used by or for the government, the right holder shall be informed promptly;

Now, from a descriptive point of view, the main purpose of regime analysis is to find adequate explanations of social behaviour; from a normative point of view, it is to find conditions of adequacy for such a behaviour. In political science, there is a debate whether regime analysis is a practical tool for such a purpose. The underlying idea of applying regime analysis is that social behaviour is causally related to *basic causal variables* like the power of institutions or the interests of agents via regimes as characterised above. Regarding this assumption, three positions can be separated (cf. Krasner 1982, pp.189ff; and Janning 2008, pp.115f): The conventional structural view denies the assumption, the modified structural view weakens it, and the so-called *Grotian tradition* shares it (the name stems from Huig de Groot, also referred to by 'Grotius', a seventeenth-century Dutch jurist who described international politics as being bound also to moral and legal imperatives).

According to the conventional structural view, to consider regimes instead of (conventionally considering) interests and power is to obscure the causes of behaviour in a multi-agent system. Instead of being relevant causal factors, regimes are considered as merely *epiphenomenal* in such an approach (cf. Strange 1982; cf. also the presentation in Krasner 1982, p.190). Against this line of argumentation, regime analysts put forward that regimes encompass principles and single norms and that just considering individual interests and power via investigations of utilities on an individual level fail (cf. Krasner 1982, p.187).

The modified structural view shares in principle the conventional standpoint, however, it considers a very narrow application of regime analysis as fruitful in cases where classical decision theoretical approaches fail. Such failings are, e.g., wrong predictions, inaccurate explanations and at least seemingly wrong conditions of adequacy. A case in point is, e.g., the prisoner's dilemma, where, according to the modified structural view, reference to coordination regimes might clarify the situation since considering individual interests would lead to irrational behaviour, whereas considering the commitments to a system of normative statements provides an incentive to act collectively rational.

Finally, the Grotian tradition considers regime analysis not only fruitful in such narrow cases of application, but as relevant in very many other cases of multi-agent systems. Followers of this tradition think that regime analysis very often gets things right by considering multi-agent systems in a not too coarse-, but also not too fine-grained resolution. It is clear that 'regime' understood in the way characterised above is a quite broad and general concept. The advantage is that this generality allows regime analysis to be applied in many areas – most common are, e.g., investigations of welfare regimes, governance regimes, regimes in privatisation and deregulation politics, as well as risk assessment regimes. Of course, this generality comes also at a cost, namely that there are only little principles governing all these kinds of regimes (cf. Janning 2008, pp.112f). Specifications of the concept are always highly sensitive to the context of application. However, regime analysts – especially those within the Grotian tradition – think that this can be done and that the concept is neither

too general nor too narrow:

> "[Regime analysis is a] 'middle way' approach to institutional analysis. It is designed to capture the variety that is left out of macroscopic [...] approaches, which inevitably can deal only in broad-gauge interpretation. At the same time, it is designed to achieve a broader and more general perspective than is yielded by microscopic approaches, which tend to focus on the setting of [specific] standards alone, or on the details of a particular [issue-area], or both." (cf. Hood, Rothstein, and Baldwin 2001, p.14)

As an example, Hood, Rothstein, and Baldwin (2001) refer to the British regulation of the use of *2,4,5-Trichlorophenoxyacetic acid* (also part of *Agent Orange*) in the agricultural industry. According to them, a too fine-grained approach of enforcing pesticide policy on the individual level led to serious misdemeanour (cf. Hood, Rothstein, and Baldwin 2001, p.15). Perhaps even more prominent is such a discussion in the realm of technology studies, particularly in the so-called multi-level perspective approach (cf. Geels 2016; and Fisher and Rip 2013). This account distinguishes three levels of systems when discussing technological innovations, namely the micro-, the meso-, and the macro-level. The macro-level is constituted by so-called *socio-technical landscapes* that affect socio-technical developments such as, e.g., [72] related effects of globalisation or related environmental problems. The meso-level is formed by so-called *socio-technical regimes*, which are also described in a likewise manner as above:

> "Regimes are [...] semi-coherent sets of rules that are linked together, and it is difficult to change one rule without altering others. The alignment among rules gives a regime stability and 'strength' to coordinate activities." (Geels 2016, p.170)

Finally, the micro-level is formed by so-called *technological niches*, the "locus for radical innovations" which deviate from the rules in the existing regime (cf. Geels 2016, pp.171). Similarly, in so-called *socio-technical integration research* perspectives on these different levels are employed: Such studies investigate "what counts as responsible innovation at the macro-level of public policy, the micro-level of laboratory research, and the meso-level of institutional structures and practices that connect them" (cf. the description of the *National Science Foundation* (NSF) as cited in Fisher and Rip 2013, p.174, fn.18). We will see below that the notion of a regime is central in such technology studies. Inasmuch as these studies focus on the unit of a *regime* when investigating socio-technical development, such studies can be also ascribed to the Grotian tradition.

We have indicated above that all three positions on the fruitfulness of regime analysis relate regimes to basic variables; e.g. the conventional structural view in a deterministic way (regimes are determined completely by actions on the individual level and by this are superfluous); and the modified structural view as well as the Grotian tradition by linking regimes and actions

on the individual level in a non-deterministic way – the latter view even allows feedback of actions in a multi-agent setting on regimes, i.e. causal cycles. Now, besides these different relations between regimes and basic variables, also what counts as a relevant basic variable (a basic *causal* variable) is seen differently. There are approaches concentrating on individual interests alone, approaches concentrating also on power (cf. Strange 1982), and approaches concentrating furthermore on individual knowledge (cf. Krasner 1982, pp.195ff). It is analysis concentrating on knowledge that allows us to specify the 'regime'-concept to the concept of so-called 'epistemic regimes':

> **Epistemic Regimes:** If the normative statements of a regime regulate mainly what counts as acceptable knowledge and what not, regulate the assessment of knowledge, and also regulate the ascription of epistemic authority as well as the way of blaming misdemeanour regarding epistemic matters, then the regime is to be considered an epistemic one.

It is important to note that this notion of an *epistemic regime* is in fact only a specification of the general notion of a *regime* (*genus*) as outlined above. The *differentia specifica* concerns the specification of the relevant norms in play, namely restricting them to the set of epistemic or knowledge norms. Interestingly, this characterisation nicely coincides – at least in relevant parts – with the above-mentioned one put forward in technology assessment studies by Böschen (2019). He characterises an *epistemic regime* ...

> "[...] as a set of discursively constructed and institutionally stabilised practices for articulating, debating and solving socio-epistemic problems, thereby constituting epistemic quality standards and legitimate ways of performing epistemic authority".

So much for the moment on conceptual matters. Let us now also briefly indicate some applications of this notions: In studies of international relations epistemic regimes, sometimes also called 'knowledge regimes', are taken to be highly relevant in explaining social behaviour – cf., e.g., (Campbell and Pedersen 2014, p.326) where it is argued for the thesis that international relations have to be investigated on the intersection of politic regimes, economy regimes, and knowledge regimes; according to Campbell and Pedersen (2014), the latter are still highly influenced by national interests despite the internationalisation of science. Epistemic regimes also play an important role in sociological studies of knowledge, as, e.g., that of Gibbons et al. (1994), where it is argued that there is a new regime of knowledge production emerging alongside the traditional, familiar one. These authors argue that the regime relevant for knowledge gathering at universities and educational platforms, so-called *Mode 1* production of knowledge, is strongly institutionalised and hierarchically structured, whereas close to a context of application so-called *Mode 2* knowledge is produced which is less institutionalised (heterogeneously organised, research teams work transdisciplinary), non-hierarchical and localised (cf. Gibbons et al. 1994, p.3). In a

similar direction goes Rammert (2006), who sees in the traditional knowledge production a process of "explicitation", whereas the new forms of knowledge production are taken to be more explorative. He also states the above mentioned identity criteria or definitional conditions for knowledge regimes explicitly: "If one can identify new patterns of coordination within [...] knowledge production, and if these patterns can be condensed into a coherent set of rules of the game, a new knowledge regime can be said to have emerged" (cf. Rammert 2006, p.256). Finally, also in science studies such a specification is to be found, e.g., in (Schützeichel 2012, p.24).

Before we go on and provide a new application of the *regime*-concept when characterising a re-entanglement of knowledge and values, we want to link this notion to other notions that are well-established in science studies, such as, e.g., the notion of a *paradigm*. As we will see, the *regime*-concept is more general and allows for embedding or re-framing the other notions.

5 Epistemic Regimes and Paradigms

Due to the generality of the regime approach, it seems to be not that surprising that the notion of an epistemic regime is closely related to other core notions of science studies. This fact is pointed out by several authors, e.g., Rammert (2006, p.270), Kaiser et al. (2010, p.188), and Schützeichel (2012, p.23). In this section, we complement but also demarcate the explicated notion of an *epistemic regime* of the preceding section by/from traditional concepts of science studies like that of a *paradigm*. We will then, in the subsequent section, indicate how newly arising epistemic regimes can be considered as re-entangling knowledge production with non-epistemic values.

Let us begin with the connection between the notion of *epistemic regimes* and similar notions of science studies. Here particularly the, in 1935 by Ludwik Fleck introduced, concept of a *thought collective* is closely related, since it also shifts consideration of epistemic matters to social rules and norms that regulate scientific knowledge. Also Thomas S. Kuhn's continuation of Fleck's pragmatic stance by uncovering regularities in the development, rise, and fall of paradigms can be considered as a special case of epistemic regime analysis: It is well-known that Kuhn's notion of a paradim is ambiguous and that in the *Postscript* of his *The Structure of Scientific Revolutions* he tried to disentangle at least two notions, namely that of a *disciplinary matrix* and that of paradigmatic examples (*exemplars*). [73] The first notion should cover the entire set of beliefs, values, and techniques shared by the members of a given community (cf. Kuhn 1962/1996, p.175), whereas the latter is about concrete problem-solutions that students encounter already from the start of their scientific education (cf. Kuhn 1962/1996, p.187). Now, if one focuses on the underlying normative statements regarding the regulation of knowledge gathering, production, and use regarding both, the disciplinary matrix as well as the exemplars, then the analysis turns to an analysis of epistemic regimes. This is simply the case, because any set of such norms to which a group of scientists adhere to, can be re-framed

also as a set of epistemic norms shared by agents (scientists) regarding an issue area (rules for knowledge production). However, that such a re-framing is not only a conceptual possibility, but in fact agrees with practice of science and technology studies, can be seen by help of the following arguments.

Consider the characterisation of an *epistemic regime* provided by Böschen (2019) and quoted above. According to this account, epistemic regimes are mainly concerned with epistemic problem-solving tasks, whereby there are three subtasks to be differentiated, namely the task of *articulating*, the task of *selecting*, and the task of *solving* problems. Whereas tasks of the latter kind might be considered to be the standard business of epistemic regimes like, e.g., scientific institutions, the former two tasks are, so to say, not day-to-day routine of science. Still, they are important components that are regulated within epistemic regimes. Problems related with the articulation task can be illustrated well by help of reference to the discussion of, e.g., *cancerogeneity of tobacco*, where, in the end it, took about half a century until the struggle between society- and industry-oriented interests was finally settled in favour of successfully articulating this problem on the basis of a scientific *paradigm* and overcoming the "regulation-avoiding strategies of the tobacco industry" (cf. Böschen 2019, p.43). The selection task is part of an epistemic regime in the sense that such a set of stabilised practices is considered to be authoritative also with respect to the question of how exactly one can formulate such a problem; so, e.g., whereas the relativity of mass might have been (NB: in fact it has not been) considered a senseless and illegitimate notion within the *paradigm* of Newtonian physics, questions centring around it became clearly not only legitimate, but even obligatory in the *paradigm* of relativistic physics. So, as one can see here, the fine-grained notion of an epistemic regime as discussed and applied with respect to technology assessment in (Böschen 2019) naturally applies also to *paradigm*-talk and hence serves as an indicator for non-artificial embedding of *paradigm*-talk into *regime*-talk.

Another indicator for the naturalness of such a re-framing is, e.g., that a dynamical description of the notions involved seems to be pretty much aligned with each other. So, e.g., the dynamics of *paradigm*-talk was spelled out by Kuhn in terms of cycles of normal science within a paradigm and scientific revolutions in form of paradigm shifts (cf., e.g., the detailed explications regarding these notions provided in Feldbacher-Escamilla and Gugerell 2010). The dynamics with respect to regimes is described, e.g., in Geels (2016, pp.173f, p.176) as a process involving all three levels (micro, meso, and macro) in four phases: In the first phase, (technical) novelties arise in "niches" (micro-level) due to problems in the existing landscape (marco-level) and regime (meso-level). The second phase is about exploration of this novelties for use in small demand-markets with new rules as a result. In the third phase, a wide diffusion happens and the novelty gets in competition with the established regime. In the fourth phase, finally, the novelty replaces the old regime. It seems obvious that this description is in structural alignment with that of paradigms, where an anomaly (cf. "niche") attracts some attention (first phase), an increasing number of scientists start to work on it and makes new framework assumptions

(second phase), a polarisation takes place between scientists sticking to the old paradigm and scientists switching to the new one (third phase), and, finally, the paradigm shift, where the new paradigm reaches the stage of institutional and educational establishment and the old paradigm declines (fourth face). The structural similarity holds the more, once one considers further specifications of the dynamics of social development in terms of regimes:

> "Only if conditions in relating regimes and landscapes are simultaneously favourable will wide diffusion of the novelty occur. Such situations are called windows of opportunity. [Circumstances ...] for windows of opportunity to arise [... are, e.g.,] internal technical problems in the regime, which cannot be met with the available technology." Geels (cf. 2016, p.174)

What is called an 'internal technical problem' here, pretty much plays the same role as *anomalies* play with respect to scientific paradigms.

Finally, and perhaps also most clearly, the possibility and naturalness of re-framing traditional notions of science studies and philosophy of science in terms of the *regime*-notion, can also be seen by help of Imre Lakatos' notion of a *scientific research programme*. Lakatos' proposal to describe and regulate the development of science by help of this notion is generally regarded as an intermediation between Kuhn's science studies approach and that one of falsificationism within the philosophy of science of Karl R. Popper. Kuhn's case studies prominently brought to the light that Popper's normative suggestions for and empirical descriptions of scientific behaviour are not adequate inasmuch as falsification plays de facto only a minor role in scientific theory construction and assessment. Lakatos tried to embed Popper's falsificationism into a "Kuhn-style" pragmatic setting by his methodology of scientific research programmes: Such a programme consists of a sequence of theories and a heuristic, where the theories share a *core*, i.e. usually the most fundamental axioms of a discipline, and differ in their *periphery*, i.e. auxiliary hypotheses, assumptions about boundary conditions, very domain-specific laws etc. The heuristic contains rules such as to stick to the core as long as possible – this is the so-called *negative heuristic* which states that a falsifying observation should not be directed against the core; but also rules that suggest to modify the periphery in such a way that it provides a "protective belt" for the core – this is the so-called *positive heuristic* which might state, e.g., that even *ad hoc* modifications of the periphery are acceptable if such modifications are only exceptional and not default. Popper's falsificationism is rescued from Kuhn's pragmatic objections by considering falsification not as a relation between pure observation and theory, but on a methodological level as a relation between negative and positive heuristics: If, e.g., by help of modification and addition of further specific laws more and more data can be explained, then a research programme is regarded as *progressive*; on the other hand, if, e.g., more and more ad hoc modifications of the periphery of a theory have to be performed in order to save the core of the theory from falsification in the narrow (Popperian) sense, then the research programme becomes *degenerative*. If a progressive research programme

turns to a degenerative one, and an alternative research programme with a different core emerges and becomes progressive, then the former research programme is regarded to be falsified in the wide (Lakatosian) sense. (cf. Lakatos 1980, sect.1.3). [74] Now, again, it is not hard to see some relation between the notion of a *scientific research programme* and that one of an *epistemic regime*: Regarding the core of a scientific research programme it suffices to consider the trivial normative statement that all followers of the programme should accept it as true and known to make it part of an epistemic regime. More rich in content is the consideration of the positive and negative heuristics which, again, directly count as normative statements about knowledge gathering and production, since they contain only rules for regulating what counts as accepted and known by a community and what not.

In the following section we want to argue that the notion of an *epistemic regime* is not only broad enough in order to allow for embedding other traditional and well-established notions of science studies and philosophy of science, but that, in contrast to the traditional notions, it covers also the relevant entities involved in the shift in public decision making towards integrating knowledge and values as indicated in section 3, namely regimes as agencies that re-entangle knowledge and values.

6 Regimes and the Re-Entanglement of Knowledge and Values

In the light of the discussion in the previous section, it might look like that both, the notion of an *epistemic regime* as well as the traditional notions of a *thought collective*, a *paradigm*, and a *scientific research programme* do not differ that much. Perhaps, talking of 'epistemic regimes' might be just another parlance for what is and can be said already with the latter notions. And indeed, as we mentioned and tried to indicate above, the notion of a *regime* is very broad and even allows for embedding the traditional parlance of science studies and the philosophy of science. However, especially Kuhn's and Lakatos's notions are intended to cover the comparison of scientific theories (disciplinary matrices) and research programmes, but not comparisons between systems of epistemic normative statements of science and other areas like politics and economics. If epistemic normative statements were relevant only within the realm of science, there should not be any difference. And indeed, there would not be any such difference, if the roles of science and public decision making were really as easily separable, as the normative ideal discussed in section 2 suggested: Values stem from politics, statistics and matters of fact from science. But, as the arguments of the former sections show, things are not that simple and epistemic normative statements are also relevant outside of science, relevant for public decision makers themselves. Furthermore, the investigations of Gibbons et al. (1994) and Rammert (2006) show that there are extra-scientific and more application-oriented epistemic realms. And finally, also a new ten-

dency in public decision making seems to de facto jettison the idea of science having explicit rights on epistemic matters. It is the tendency to complement the traditional model of having separate sources for knowledge and values by a model of gathering both from one and the same source in so-called *regulatory agencies*. Public decision making in the former model might be sloppily described as science plus politics equals knowledge plus values, whereas in the new model it might be characterised as regulatory agencies equal knowledge plus values. This tendency is observable, e.g., in the quite new EU governance model, where authority in public decision making is delegated by the EU institutions like the commission to regulatory agencies (cf. Janning 2008, p.124). One indicator for such a shift in the governance model is the increasing number of regulatory agencies established by the EU (see figure 1).

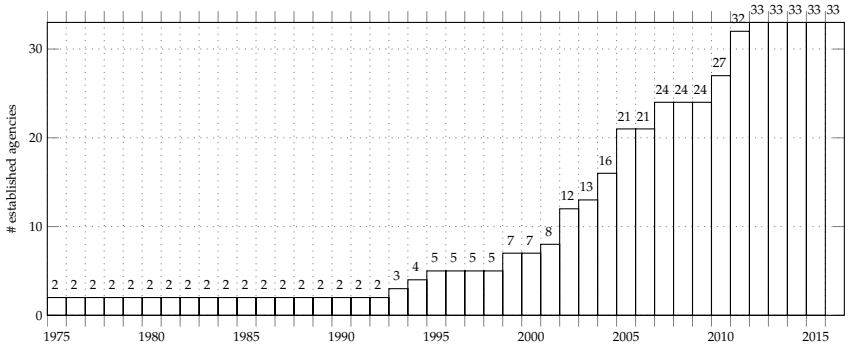

Figure 1: Number of decentralised agencies of the EU established between 1975 and 2016, starting with the *European Centre for the Development of Vocational Training* (1975) and ending with the *European Agency for the operational management of large-scale IT Systems in the area of freedom, security and justice* (2012). Source: https://europa.eu/european-union/about-eu/agencies_en, accessed: 2019-09-01;

The task of such agencies is described by the EU as follows: "These agencies have been set up by the EU to perform technical and scientific tasks that help the EU institutions implement policies and take decisions. They are spread across the EU" (source: cf. figure 1). An explanation for such a model shift is seen in the increased acceptability of regulations performed by such an agency, and not by central organs of the EU itself: Regulations which were directly performed by the EU commission were considered to be politically overdetermined by specific interests of EU member states. In a sense, epistemic authority or the reliability of the epistemic foundation of such decision making was considered to be undermined due to national-economic conflicts of interest. In contrast, the delegation of political authority to regulatory agencies increases the credibility, acceptance, [75] and enforcability of public decisions, also with respect to authority in epistemic matters (cf. Janning 2008, p.124). Such a con-

sideration of a re-entanglement as we suggest with respect to regulatory agencies finds, again, a match in science and technology studies: So, e.g., Fisher and Rip (2013, p.178) state for the sector of technology that "there is an opening in the sense that anticipation of societal impacts is now seen as being also a responsibility of technology developers".

We have seen above that the structure of the normative statements of a regime is separated into three control components: normative statements (i) regarding information gathering, (ii) regarding the setting of standards, and (iii) regarding the modification of behaviour. Normative statements that intend to modify behaviour might be considered to be parts of the context of application, and hence are not tackled by the value-neutrality postulate. However, focusing on epistemic regimes and the different contexts of science, it seems to be natural to assign normative statements regarding information gathering and the setting of standards as part of the context of justification. That an agency or a collective of agencies does not only put forward epistemic standards, but is also considered to be authoritative in this respect, is what makes it an epistemic authority and is what makes the posited (or stably agreed on) set of normative statements an epistemic regime configuration or formation. In this respect, agencies (or *epistemic regimes* in the agential sense as outlined in the characterisation of *regimes* in section 4) that have to make suggestions for decisions or decisions on their own are themselves dealing with both components, values and knowledge, and it is institutionally not clear whether values might also enter the context of justification via the norms put forward in components (i) and (ii). It is here where we diagnose a new form of entangling knowledge and values again. Such an entanglement seems to be less present in case of neighbouring notions of *epistemic regimes* such as that of a *thought collective*, a *paradigm* or a *scientific research programme*, since the characteristic properties of these notions are about methodological norms alone, whereas for *epistemic regimes* also norms of control in the sense presented above are characteristic.

Just to illustrate this institutional entanglement of knowledge and values a bit better, we want to briefly consider a case of recent decision making by an epistemic regime regarding the approval of herbicides within the *European Union* (EU): According to Article 11.4 of the *Treaty on the European Union* a collection of more than one million citizens of member states of the EU can trigger an invitation to the *European Commission* to submit a proposal on matters where the citizens think that a legal act of the EU is required. The initiative *Ban Glyphosate and Protect People and the Environment from Toxic Pesticides* triggered such an invitation on October 6, 2017 (cf. European Commission 2017, sect.1). Under debate was, amongst others, the approval of a herbicide by the EU, namely glyphosate. Glyphosate was accepted by the EU since mid 2002 and is used as herbicide, primarily to dispatch undesired plants which compete with cultivated crops. In general, after approval of an active substance by the EU, national authorities in each member state of the EU can still refuse or restrict the use of such a substance based on particular agricultural and environmental circumstances in their territory (cf. European Commission 2017, sect.2.1), however, the use of glyphosate was permitted by all big agricultural member

states of the EU. At the beginning of 2015 the *International Agency for Research on Cancer* (IARC, which is the cancer agency of the *World Health Organisation*) published a study on glyphosate concluding that the herbicide might cause cancer in humans. For this reason the *European Food Safety Authority* (EFSA), which provided scientific expertise for the approval of glyphosate in 2002, was asked to take this new study into account and provide a new estimation of possible hazards of the herbicide. EFSA concluded that "glyphosate is unlikely to pose a carcinogenic hazard to humans" (cf. European Commission 2017, sect.3.1.1).

Due to the diverging assessment of IARC and EFSA, the European Commission requested the *European Chemicals Agency* (ECHA) to make a suggestion for a decision based on both estimations. ECHA is one of the EU agencies we were in general talking about above. According to its own description:

> "The European Chemicals Agency (ECHA) is the driving force among regulatory authorities in implementing the EU's groundbreaking chemicals legislation for the benefit of human health and the environment as well as for innovation and competitiveness." (see: `https://echa.europa.eu/about-us`, accessed: 2019-09-01)

Since the task of the agency is to implement chemical legislation, but also gather knowledge about chemicals and their hazards, both components, the value and the knowledge component, are present in the agency. Regarding glyphosate, in mid 2017 ECHA concluded that it *should* not be classified as carcinogenic hazard to humans. This led to the renewal of the approval of the substance for another five years. It is interesting to note that the initiative of the EU citizens had a second aim directed against a shift of knowledge production to the private sector where due to the interests of a herbicide producing company values might easily enter scientific assessment. According to the second aim, the EU was asked to "ensure that the scientific evaluation of pesticides for EU regulatory approval is based only on published studies, which are commissioned by competent public authorities instead of the pesticide industry" (cf. European Commission 2017, sect.3.2).

A similar line of argumentation regarding the role of regimes, but with a much more generalised application, is presented by Barben (2007). Here it is claimed that, e.g., the 1970s-suspension of the *Bretton Woods system* which obliged the global economic players of the twentieth century (USA, the countries of Western Europe, Japan etc.) to tie their currency to the gold standard led to a regulation shift to the markets by which "the global financial markets gained power over national governments" (cf. Barben 2007, p.59). Roughly speaking, similarly to the role of regulative agencies, also the international markets took over the role of providing normative standards and descriptive expertise. Barben (2007) lists further examples that display the shift of the decision making task to regulative agencies as not only a local phenomenon, but a global one. Just to mention another one, the problems of global climate and environmental change led to the establishment of international consortia like the *Intergovernmental Panel on Climate Change IPCC* (cf. Barben 2007, p.60).

We think that the conceptual framework of epistemic regimes and these examples show that there is a third way of re-entangling knowledge and values, and that this way is becoming more and more influential. According to this approach knowledge and values are not re-entangled via incorporating values to academic science; they are also not re-entangled via outsourcing knowledge production to the private industry. Rather, they are intertwined in new forms of epistemic regimes which have public authority for setting values and which, at the same time, produce knowledge themselves.

7 Conclusion

Knowledge and values are the two main ingredients of decision making, *collective* knowledge and values that of *public* decision making. [76] Historically seen, both were entangled for a long time. But at the beginning of the twentieth century a new paradigm of value-neutral science arose, which led to a disentanglement in the production of both factors. However, for theoretical and practical reasons a complete demarcation of both processes seems to be inadequate, for which reason one way or another both were considered to be successively re-entangled again. One important way of re-entanglement consists in incorporating (non-epistemic) values into the enterprise of scientific justification. Another one consists in a decentralisation of knowledge production from the academic sector also to the private sector. However, as we highlighted in this paper, there is also a third way of re-entangling knowledge and values which seems to become increasingly important, namely that of newly formed epistemic regimes as, e.g., agencies set up for public decision making. Next to our pointing to this further possibility of entangling knowledge and values on the background of the former paradigm of value-neutral science, we have also provided a conceptual analysis of the notion of such *regimes*, their diverse control elements, and their similarities and dissimilarities to other notions that are well entrenched in science studies as, e.g., that of a *thought collective*, a *paradigm* or a *scientific research programme*.

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References

Barben, Daniel (2007). "Changing Regimes of Science and Politics: Comparative and transnational perspectives for a world in transition". In: *Science and Public Policy* 34.1, pp. 55–69.

Bjornberg, Jennifer (2012). "Brazil's Recent Threat on Abbott's Patent: Resolution or Retaliation". In: *Northwestern Journal of International Law & Business* 27 (1), pp. 199–226.

Böschen, Stefan (2009). "Hybrid regimes of knowledge? Challenges for constructing scientific evidence in the context of the GMO-debate". In: *Environmental Science and Pollution Research* 16.5, pp. 508–520. DOI: 10.1007/s11356-009-0164-y.

— (2016). *Hybride Wissensregime. Skizze einer soziologischen Feldtheorie*. Baden-Baden: Nomos.

— (2019). "TA at the Crossroads: Politics of TA from the viewpoint of societal problem solving". In: *Technological Forecasting & Social Change* 139, pp. 42–47. DOI: 10.1016/j.techfore.2018.07.004.

Campbell, John L. and Pedersen, Ove K. (2014). *The National Origins of Policy Ideas. Knowledge Regimes in the United States, France, Germany, and Denmark*. Princeton: Princeton University Press.

Christian, Alexander (2017-09). "On the Suppression of Medical Evidence". In: *Journal for General Philosophy of Science* 48.3, pp. 395–418. DOI: 10.1007/s10838-017-9377-9.

Christian, Alexander and Feldbacher-Escamilla, Christian J. (submitted). "Citizen Science and the Social Responsibility of Science". In: *manuscript*.

Douglas, Heather (2000). "Inductive Risk and Values in Science". In: *Philosophy of Science* 67.4, pp. 559–579. DOI: 10.1086/392855.

European Commission (2017). *Communication from the Commission on the European Citizens' Initiative "Ban glyphosate and protect people and the environment from toxic pesticides"*. Tech. rep. 12.12.2017, C(2017) 8414 final. Strasbourg: European Commission. URL: https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_glyphosate_eci_final.pdf.

Feldbacher-Escamilla, Christian J. and Gugerell, Stefan H. (2010). "Rezension: Thomas Kuhn". In: *Kriterion – Journal of Philosophy* 23.1, pp. 91–99.

Fisher, Erik and Rip, Arie (2013). "Responsible Innovation: Multi-Level Dynamics and Soft Intervention Practices". In: *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. Ed. by Owen, Richard, Bessant, John, and Heintz, Maggy. Chichester: John Wiley & Sons. Chap. 9, pp. 165–183. DOI: 10.1002/9781118551424.ch9.

Gaertner, Wulf C. (2009). *A Primer in Social Choice Theory*. Revised Edition. Oxford: Oxford University Press.

Geels, Frank W. (2016). "Multi-Level Perspective on System Innovation: Relevance for Industrial Transformation". In: *Understanding Industrial Transformation: Views from Different Disciplines*. Ed. by Olsthoorn, Xander and Wieczorek, Anna J. Dordrecht: Springer, pp. 163–186. DOI: 10.1007/1-4020-4418-6_9.

Gibbons, Michael, Limoges, Camille, Nowotny, Helga, Schwartzman, Simon, Scott, Peter, and Trow, Martin (1994). *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London: SAGE.

Hand, Eric (2010). "People Power". In: *Nature* 466.5, pp. 685–687.

Hempel, Carl G. (1965). *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*. New York: Free Press.

Hood, Christopher, Rothstein, Henry, and Baldwin, Robert (2001). *The Government of Risk*. Oxford: Oxford University Press.

Janning, Frank (2008). "Regime in der regulativen Politik. Chancen und Probleme eines Theorietransfers". In: *Die Zukunft der Policy-Forschung: Theorien, Methoden, Anwendungen*. Ed. by Janning, Frank and Toens, Katrin. Wiesbaden: VS Verlag für Sozialwissenschaften, pp. 112–137. DOI: 10.1007/978-3-531-90774-1_7.

Jeffrey, Richard C. (1983). *The Logic of Decision*. Second Edition. Chicago: The University of Chicago Press.

Kaiser, Mario, Kurath, Monika, Maasen, Sabine, and Rehmann-Sutter, Christoph, eds. (2010). *Governing Future Technologies. Nanotechnology and the Rise of an Assessment Regime*. New York: Springer.

Koslowski, Peter (1997). "Economics as Ethical Economy in the Tradition of the Historical School". In: *The Theory of Ethical Economy in the Historical School. Wilhelm Roscher, Lorenz von Stein, Gustav Schmoller, Wilhelm Dilthey and Contemporary Theory*. Ed. by Koslowski, Peter. Berlin: Springer, pp. 1–14.

Krasner, Stephen D. (1982-03). "Structural Causes and Regime Consequences: Regimes as intervening variables". In: *International Organization* 36 (02), pp. 185–205. DOI: 10.1017/S0020818300018920.

Kuhn, Thomas S. (1962/1996). *The Structure of Scientific Revolutions*. 3rd Edition. Chicago: University Of Chicago Press.

Lakatos, Imre (1980). *The methodology of scientific research programmes*. Ed. by Worrall, John and Currie, Gregory. Cambridge: Cambridge University Press.

Longino, Helen E. (2008). "Values, Heuristics, and the Politics of Knowledge". In: *The Challenge of the Social and the Pressure of Practice: Science and Values Revisited*. Ed. by Carrier, Martin, Howard, Don, and Kourany, Janet A. Pittsburgh: University of Pittsburgh Press, pp. 68–87.

Maasen, Sabine, Kaiser, Mario, Reinhart, Martin, and Sutter, Barbara, eds. (2012). *Handbuch Wissenschaftssoziologie*. Wiesbaden: Springer VS.

Rammert, Werner (2006). "Two Styles of Knowing and Knowledge Regimes: Between 'Explicitation' and 'Exploration' under Conditions of Functional Specialization or Fragmental Distribution". In: *Innovation, Science, and Institutional Change*. Ed. by Hage, Jerald and Meeus, Marius. Oxford: Oxford University Press, pp. 256–286.

Rudner, Richard (1953). "The Scientist Qua Scientist Makes Value Judgments". In: *Philosophy of Science* 20.1, pp. 1–6. DOI: 10.1086/287231.

Schützeichel, Rainer (2012). "Wissenschaftssoziologie". In: *Handbuch Wissenschaftssoziologie*. Ed. by Maasen, Sabine, Kaiser, Mario, Reinhart, Martin, and Sutter, Barbara. Wiesbaden: Springer VS, pp. 17–26.

Soyfer, Valery N. (2001). "The Consequences of Political Dictatorship for Russian Science". In: *Nature Reviews* 2 (9), pp. 723–729.

Steele, Katie and Stefánsson, H. Orri (2015). "Decision Theory". In: *The Stanford Encyclopedia of Philosophy (Summer 2018 Edition)*. Ed. by Zalta, Edward N.

Strange, Susan (1982-03). "Cave! hic dragones: a critique of regime analysis". In: *International Organization* 36 (02), pp. 479–496. DOI: 10.1017/S0020818300019020.

Weber, Max (1913/2012). "The Meaning of 'Value Freedom' in the Sociological and Economic Sciences". In: *Max Weber. Collected and methodological writings*. Ed. by Weber, Max. Translated by Hans Henrik Bruun. Oxon: Routledge, pp. 304–334.